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ABSTRACT

The need for study programs that fit better to the characteristics of learners, their interests, and the labor market has led education from being supply driven toward being demand driven. The construction of individual study programs requires appropriate assessment methods. The technologies generally available for assessment seem to reinforce the supply-driven nature of assessment, but demand-driven education, where students influence content selection and teaching is growing. The central finding of research of the past 15 years is that the key to developing an integrated and generative knowledge base is to build on the learner's prior knowledge. An empirical study is reported that focuses on the application of new forms of assessment for individual study programs, concentrating on prior knowledge and progress assessment. Questionnaire responses of 2,000 university students show that students largely agree with the use of prior knowledge state and progress tests and that their aims are improvement of knowledge and of study methods. Seven graphs and one table present study findings. (Contains 60 references.) (SLD)

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Recent developments concerning individual study programmes in higher education and alternative assessment procedures for students.

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Paper of the EARLI SIG Assessment and Evaluation
Symposium at AERA 94 Annual Meeting

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Abstract

The need for study programmes that fit better to the characteristics of the learner, his interests and the changes in the labour market has become a subject for researchers in recent years. This evolution of education from being supply driven towards being demand driven needs to be understood in the larger context of societal, economic, political, scientific and technological developments. From an educational point of view, the construction of individual study programmes needs appropriate assessment methods for students.
The paper focuses generally on the predominance of supply driven education. The small set of available 'technologies' seems to reinforce the nature of supply driven education. Supply driven education is pressurised by changes in the societal context. Educational theories proclaim new ideas, but in general educational practice reflects predominantly supply driven features. The same seems to be true of the emerging IT-applications. During the last decade, demand driven education, where students influence content selections and didactical elaborations, gets growing attention.

In a first part, the paper focuses at the theoretical background of the problem of appropriate assessment methods for such flexible study programmes. The central finding of investigations of the past fifteen years is that a key to developing an integrated and generative knowledge base is to build upon the learner's prior knowledge. Glaser and De Corte state: "Indeed, new learning is exceedingly difficult when prior informal as well as formal knowledge is not used as a springboard for future learning. It has also become more and more obvious, that in contrast to the traditional measures of aptitude, the assessment of prior knowledge and skill is not only a much more precise predictor of learning, but provides in addition a more useful basis for instruction and guidance" (in: Dochy, 1992). Past research has shown that prior knowledge has a main influence on the learning of students and is a better predictor for study success than other variables. Also the variables 'study progress' and 'knowledge gain' has shown to be useful predictors for study success (Imbos, 1991; Tan & Imbos, 1993). Moreover it has become clear that the use of assessment techniques as instruments for gathering information on study progress and for directing study guidance should be increased. However, implementing such research results in educational practice is not that easy.

In a second part, an empirical study is reported. This study is focussing a first step in the application of new forms of assessment for individual study programmes, i.e. prior knowledge state and progress assessment. This first step is a clear answer to the question if students themselves do support the 'overall assessment prophecy' and if and how they do intend clearly to use the instruments. The present study investigates this matter, i.e. students' perceptions, using a questionnaire for a sample of 2000 university students.
The results show that students largely agree with the prophecy and show a high preparedness to use the proposed assessment instruments, being prior knowledge state tests and progress tests. Remarkable is the finding that students do want to use the instruments for strongly different purposes (knowing their strenghts and weaknesses; directing their study guidance; attaining the fastest study progress as possible within their study programmes) and that there are differences between specific domains and between beginning and advanced students.

1 Introduction and theoretical background

1.1 Earlier research on prior knowledge and progress

Earlier research (Dochy, 1992; Dochy & Valcke, 1993; Dochy & Alexander, 1994) shows that prior knowledge of students is a determining factor in the learning process of students in higher education, both in a regular university as in a distance teaching university. A methodology for using Prior Knowledge State Tests was introduced. This methodology took as a starting point the finding that the structure is one of the most important aspects in taking the students' prior knowledge into account.
Starting from the overall-assessment prophecy, i.e. that assessment becomes an integral part of instruction, we have investigated the usefulness of introducing tests for assessing the prior knowledge state of students at the beginning of a their study. A similar procedure for assessing the students' knowledge states during the study period has been called progress tests (Dochy & Bouwens, 1992; Dochy, 1992).

1.2 A conceptual framework for studying knowledge acquisition and the structure of knowledge

Starting from a European-American conceptual framework (Dochy & Alexander, 1994), the prior knowledge state (PKS) is defined as the knowledge state comprising existing declarative and procedural knowledge which meets the following conditions: it is present before the implementation of a particular learning task, it is available or able to be recalled or reconstructed; it is relevant for the achievement of the objectives of the learning task, it is organized in structured schemata, it is to a certain degree transferable or applicable to other learning tasks, it is dynamic in nature. For a clear definition of all terms used in relation to knowledge acquisition we refer to Dochy and Alexander (1994).

The structure of knowledge issue has been dealt with by a variety of theoretical disciplines: cognitive psychology, educational psychology, artificial intelligence, etc. From a pragmatic point of view the issue has also been of prime importance in applied sciences like instructional psychology, curriculum development theories and psychometrics. An early, cognitive-theoretical approach appears in the work of Ausubel (1968) who argues that new knowledge is only acquired to the extent that it is meaningfully related to existing knowledge. Ausubel maintains that knowledge is organized primarily in a hierarchical fashion, which implies that mastery of higher knowledge levels assumes mastery of all lower knowledge levels. Additionally, Ausubel advances that the various pieces of information integrated within a particular knowledge structure are highly interrelated. Thus, the more structured prior knowledge, the more flexible and easy the acquisition of new knowledge becomes.

Ausubel's conceptualization of learning as the assimilation into prior knowledge, is echoed and extended in Mayer's (1979) schema theory. New knowledge is - according to Mayer - assimilated into a hierarchy of progressively more specific content within the learner's knowledge base. Thus, the basic learning process can be described as the assimilation of new knowledge within hierarchically ordered schemata.

Another benchmark is set by the 'elaboration theory'. According to this theory, multiple access avenues become available to the learner by the activation of alternate relational paths. This theory also depended on the assumption that knowledge acquisition is facilitated to the extent that information is organized in a hierarchically integrated mode (Reigeluth & Stein, 1983).

From a rather pragmatic, e.g. instructional-psychological, point of view the structure-of-knowledge paradigm needs to be investigated in detail in order to find more efficient ways for using instructional technology. Research into ways of utilizing knowledge states (Dochy, 1992) indicate e.g. that the different components of the PKS should be taken into account (e.g. at the subject-matter level) and that components of the PKS along other dimensions (e.g. educational-psychological dimension) could be helpful in educational settings for diagnosis and as a basis for intervention.

An important conclusion from our former research indicates that it looks promising to analyze in more detail the complex of components of the Knowledge States (KS). A first attempt in this direction focused on the structure of the PKS along the content dimension (Dochy, 1992). Note that we use the term 'component' to

refer to these subparts of the prior knowledge state that relate to a specific parameter along a knowledge profile dimension, as our knowledge state tests did refer to at the content dimension.

In order to clearly understand this statement, it is necessary to stress that three important concepts are introduced in the former paragraph: the KS, components of the KS and a complex of components. These three concepts refer to the value attached to the specific 'structure' of the KS. Our earlier research revealed that such a structure could be indicated in prior knowledge, e.g. along the content dimension. We did for instance discriminate between the optimal requisite prior knowledge state and the mathematics prior knowledge state. But it was also suggested that the differentiation of components of the KS along other dimensions could be helpful to diagnose and support educational practice. For a clear distinction between 'parameter' and 'dimension' we refer to Figure 1.

1.3 Knowledge profiles

As such, the concept of 'knowledge profiles' is not found in literature. Only 'student profiles' (Wolf, et al., 1991) and 'cognitive profile' (Letteri et al., 1982) have some similarity in meaning.
Our use of the concept 'profile' is derived from the practice, common in educational research, of plotting as a graph (or profile) the raw or standardized scores of a group or individual on certain parameters (Keeves, 1988). In analyzing research data, comparisons are made between persons or groups of persons in terms of a set of measurements about related aspects. For each person or group a profile can be obtained by combining the results of the set of parameters. The comparison between individual profiles is known by the generic term 'profile analysis'.

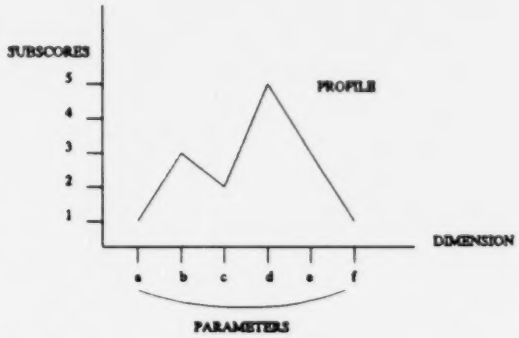

Figure 1: Example of a knowledge profile

Figure 1 shows the relationships between some key concepts. A 'dimension' is the basis to construct a knowledge profile. Each dimension represents an approach towards the structure of knowledge since it introduces a related set of KS components. These components are named parameters.

From an instructional-psychological point of view, knowledge profiles can give practical indications of student achievement and learning, thereby making it possible to direct the learning process. In a recent overview of student assessment, Wolf et al. (1991) advocated this approach. According to these authors, there is a need for new educational psychometrics in line with the much changed perceptions of educational achievement. The educational world must come to terms with new premises, multiple paths towards the prior knowledge state, more developmentally-oriented assessments and the students entering school with widely varying backgrounds. For our part, we take account of these changes by trying to identify the components of the prior knowledge state, by implementing prior knowledge state tests and by initialisation of plans to use these tests several times a year to monitor students' progress.

In this context it is necessary to come to an agreement on the relevant parameters for describing student performance and it is critical to develop ways of looking at 'student profiles': " unless we develop these kinds of differentiated portraits of student performance within a domain, it is difficult to envision student assessment ever informing, rather than merely measuring, the educational process" (Wolf et al., 1991).

Our multi-profile approach generates 'profile analysis' (Dochy & Valcke, 1993; Valcke & Dochy, 1991), an application of multivariate analysis of variance (MANOVA) in which several dependent variables are measured on the same scale (Tabachnick & Fidell, 1989). This profile analysis can provide relevant information with diagnostic and remedial value. In this way, the profiles help us to identify learning deficits to be remediated.

Data were found that support the relevance and validity of the knowledge profile dimensions. Two approaches were to be adopted, based on data gathered during an investigation involving a large sample of university students. First, we analyzed the extent to which the parameters along the dimensions give information about different components of the PKS. Second, we analyzed the discriminatory power of the knowledge profile dimensions to make apparent PKS differences between a variety of student sub-populations (Wagemans et al., 1991; Valcke & Dochy, 1991; Dochy & Valcke, 1993).

2 The scope of the present investigation

The starting point of this investigation has been a variety of problems observed in the context of higher education, e.g. the problem of equal opportunities for all students at the start, the problem of multifunctionality of modules in modular education, the problem of sequence in which course modules are studied, the problem of differing students, the problem of making appropriate use of prior knowledge. Prior knowledge is a central issue in relation to each of these specific topics.

To solve these problems, it is not enough to work out a methodology and practical instruments. Our new approach towards the analysis of prior knowledge foresees that in situations where there are significant differences between the PKS of specific subpopulations, the profile dimensions will be helpful to detect and dissect in more detail the strengths and weaknesses of the students involved. This might be a promising starting point for differentiated diagnostic and guidance approaches.

Next to that, a clear view on how students perceive these new instruments and on their future habits will be necessary: their needs, their preparedness to use, their possible investment, etc. This will be investigated in the present study. A sufficient acceptance for the overall assessment prophecy and its practical implementation will urge to a new teaching-learning model as presented in Figure 2.

Then instruction is to be reconsidered, at least in open learning environments, on the basis of a new educational model of the learning process in which the overall assessment takes a central place and the students' prior knowledge state is the starting point.

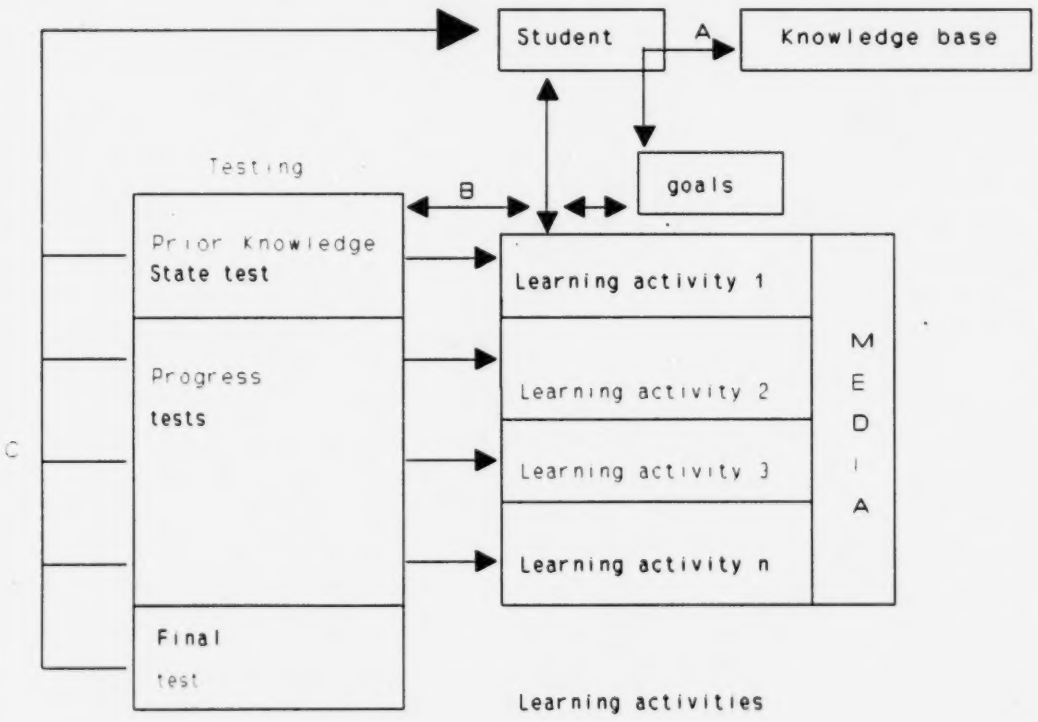

Figure 2: Assessment at the core of the teaching-learning model

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According to this model, the student starts with stating his learning goals. These relate to a certain part of the knowledge base (the content or the whole of a university's courses)(arrow A). After having taken a prior knowledge state test, the learning goals are reformulated (if necessary) and the students start with the appropriate learning tasks (arrow B). During the learning process the student takes progress tests regularly to check his progress, to determine the required guidance and to identify the subsequent learning tasks (arrow C).

2.1 Underlying for theory driven assumptions

2.1.1 Effects of prior knowledge

Earlier cited theories of Ausubel, Mayer, and Reigeluth & Stein are important since they stress the 'structured', hierarchical nature of prior knowledge and indicate that prior knowledge is an important variable in learning. Additional support, especially for the importance of prior knowledge in learning (measured by a Prior Knowledge State Test), both in the sense of high correlations and highly explained variance (20 to 45% in ecologically valid settings and up to 90% in experimental settings), has been provided by the investigations of Bloom (1976), Lodewijks (1981), Parkerson et al. (1984), Kõrkel (1987), Alexander et al. (1989), Weinert (1989), Minnaert and Janssen (1992), Dochy (1992) and Valcke and Dochy (1991). From these investigations, one can derive that the 'building' comparison is important in learning, which means that the student's knowledge state is not only important at the start of his study, but remains an important variable during the study (i.e. at the start of each building block, at the beginning of each learning task, etc.).

Although - as shown earlier - the impact of prior knowledge is often stressed to this extent that all learning might even depend on it (Resnick, 1981), also other factors like other student characteristics do influence the learning process and can interact with the impact of prior knowledge. But, it is not yet clear which personal or contextual variables play a significant role in this context (Ferguson-Hessler, 1989). Differentiating between groups of students on the basis of such variables does not seem to make much sense for educational practice. Moreover, our research indicates that, if different variables are taken into account, prior knowledge always has the strongest general effect and overrules other variables in descriptive and explanatory models (see also Ethington, 1990; Bruinsma & Geurts, 1988; Dochy, 1988). Analysis in terms of the High Knowledge (HK) and the Low Knowledge (LK) groups (in the sense of higher education and duration of work experience) show a clear distinction between groups (Dochy & Steenbakkers, 1988). The majority of the HK group students found the course easy, whereas the opinions of the LK group students were divided. This assumption supports the general results of research into prior knowledge and the fundamental issue of the different Prior Knowledge theories, i.e. that students' prior knowledge makes learning easier.

This can be explained by the influence of the direct effect of prior knowledge on learning. By direct effect is understood all effects as found in situations in which prior knowledge was found to perform an influence on study results of students. In those studies, the amount of knowledge at which the student has the disposal of, is directly related to the expected study success (see Niestadt & Dochy, 1992). Certainly there are investigations which contradict the general direct effect. The study by Palmer et al. (1979) is such an example. However, they conclude that having high school economics may in some cases mislead them into over-confidence.
Besides studies into direct effects of prior knowledge on study results, research has been done into the indirect effects on study results, for example effects on study time. Indirect effects come to surface when investigating for example interactions between prior knowledge and instruction. Prior knowledge is here found to have effects on study results that are not plainly caused by the knowledge possessed. In those studies, prior knowledge is found to affect the required time for study, the effort one has to spare, etcetera. When we draw our attention to the indirect effect of prior knowledge, then all consequences of prior knowledge are paramount, in which prior knowledge appears to be of influence for effects which, in turn, directly affect a student's study results. For example, Saunders (1980) found that students who had taken one or more domain-specific high school courses knew significantly more at the end of a university principles course, even though they reported working significantly fewer hours on the university course. Other researchers (see Niestadt & Dochy, 1992) concluded students with high SAT scores learned more per time unit in any type of intellectual endeavour. A conclusion from these studies into indirect effects can be that instruction affects new achievements as it interacts with the

learner's prior knowledge state or his familiarity with the subject matter. Tobias (1976) described a range of levels of instructional support and embedded support devices which can minimize individual differences between students. This proposal seems to find a reasonable basis in educational research. The well-known study of Bonello (1984) was already a clear warning to education based on self-study in the sense that in providing courses to students with different prior knowledge levels, one should take account of these differences in the individuals' materials.

The facilitating effect of prior knowledge is generally recognized by educational researchers as being the most important positive effect on learning. In Dochy (1992) different theories that give an explanation for this finding are explained. Nevertheless, we should not forget that not all facilitating effects are the 'direct' results of prior knowledge. For the purpose of this review, we can make a distinction between:

a. a direct effect of prior knowledge facilitating the learning process and leading to better study results;
b. an indirect effect of prior knowledge, optimizing the clarity of study materials; and
c. an indirect effect of prior knowledge, optimizing the use of instructional and learning time.

Further, given the fact that we will look for differences between domains in the present study, it is important to stress that it has been convincingly shown that prior knowledge states of students are highly domain-specific, assuming that students will learn more effectively in some domains than in others (Alexander, 1992; Alexander & Kulikowich, 1991; Dochy, 1992).

2.1.2 Students' perceptions of their own prior knowledge

An additional approach to determine the prior knowledge level of the students, is to ask the students themselves to estimate their mastery level. In an experiment by Lodewijks (1981), it was shown that prior knowledge could account for 36% of the explained variance in post-test scores. In this instance prior knowledge was considered to be the subjective rating of familiarity with the content of the learning task. However, when considering the Falchikov and Boud (1989) meta-analysis of 48 student self-assessment studies, the researchers came to more differentiated conclusions: most studies found positive effect sizes, indicating overrating on the part of the students. It appears that more experienced students in a particular field (that is, students with more prior knowledge) are more accurate estimators, whereas students taking introductory courses appear to make particularly inaccurate self-assessments.
In our own study (Wagemans, Valcke & Dochy, 1991), it was shown that the estimation of PKS level through self-assessment by the students is not very reliable in comparison with objective prior knowledge state tests. The estimations do not reflect the levels of PKS as measured by the (two different) objective tests (Figure 3 and 4). For our purpose, it can be concluded that self-assessment is not useful, at least not for introductory courses, as also shown by Falchikov and Boud (1989). Moreover, it was found that students have very differing conceptions of 'prior knowledge', which makes a self-rating procedure invalid (Dochy, 1992).

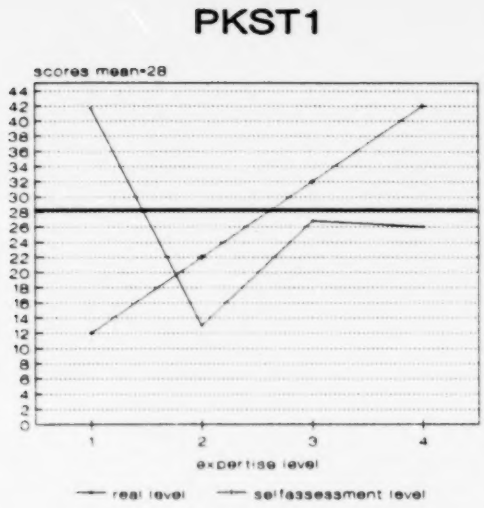

Figure 3: Differences between self-assessment levels and real PKS levels (PKST1)

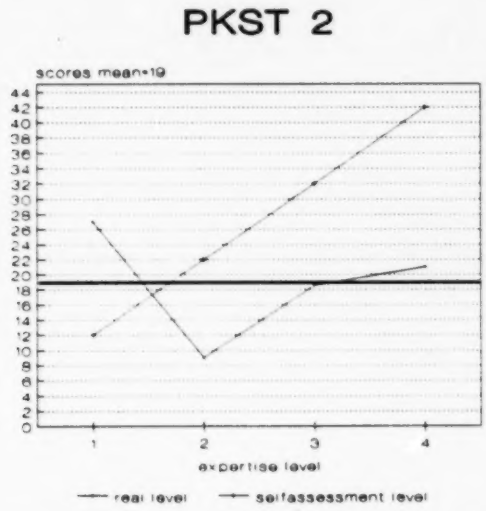

Figure 4: Differences between self-assessment levels and real PKS levels (PKST2)

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2.2 Assessment procedures

2.2.1 Final examinations

Several assessment procedures have recently been operationalised at our university in a distance education context. Next to the traditional administration of paper-and-pencil examinations in study centres (including multiple-choice format to open-ended questions) on the occasion of three moments a year, the SYS-system is used. In the SYS-system, the computer generates a unique examination for each individual student by selecting items from an item-bank. This automated evaluation format fits extremely well in the Open university philosophy guaranteeing a high degree of openness and flexibility. The student can take a final examination any moment he wants to. The necessity to inform the study centre about the intent to take an examination two weeks beforehand is the only time-limitation. After solving the questions and problems, the student gets feedback about his final score. This score is confirmed about two weeks later after item-analysis and test-analysis.
Information is available about appreciation and the perception of students of the SYS-evaluation format. In a 1991-study among 1123 Open university students, attitudes towards the SYS-evaluation system were as follows: 43% said they consider the system to be moderately suited, 50% indicated the system was well suited. In a comparable 1992-study among Ou-students, the appreciation of this examination format raises up to 62% of the students (1992-II). When asked to choose among three examination formats, students favoured the most flexible format (SYS-examination). Two consecutive studies revealed the following proportions:

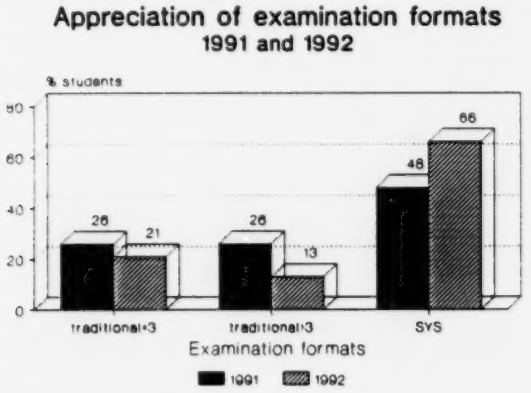

Figure 5: Appreciation of examination formats

The data in figure 5 undoubtedly indicate the growing appreciation of the SYS-system. This obvious preference for SYS-examinations does not differ between students studying different domains (1991-II and 1992-I). Further analysis of the quantitative results reveal that students especially appreciate the SYS-format because it allows to adapt the examination-moment to the personal study plan.

Apart from evaluative data about the SYS-examination system, there is hardly information available about the student opinions in relation to the more traditional examination procedures or the examination content, the types of items, etc. in general. Moreover, and related to the topic of this research, we observe that nearly all investments in evaluation has been in relation to 'final examinations/tests'. Prior knowledge state tests and/or progress tests only recently have been considered as possible topics for a substantial investment in educational research and development.

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2.2.2 Alternative assessment procedures: prior knowledge and progress tests

Prior knowledge state tests (PKST) related to the content of a course have showed to be highly reliable instruments (for economics and mathematics, see Dochy, 1992; for history, see Elen, 1993) with a high predictive validity as stated earlier. In his profound investigation into prescription for instructional design, Elen (1993) concludes that from his different design parameters (cognitive skills, metacognitive knowledge and skills, and prior knowledge), only "prior knowledge has been shown to significantly affect learning outcomes and is to a certain extent also of determining importance". According to Elen, the value of prior knowledge cannot be underestimated.

Further, from our experiences at the university of Maastricht, a university with a problem-based curriculum using progress tests four times a year for all students, it was clear that using tests several times a year to monitor students' progress was a very useful and informative source, both for students and for professors (Dochy & Wijnen, 1987).In a study concerning the use of progress tests, Imbos (1989) concluded that progress tests are very useful, even for first year students. He discriminated between 'first year curriculum items' and 'general items' and found that laymen have a chance for success of .14 on first year items and are able to answer one third of the questions. Imbos suggests two concrete aspects for amelioration of progress tests: (1) ordering the items based on p-values and (2) giving students who score vary low a tailored test (selected sample of the same itembank adapted to his prior knowledge level).
Shavelson, Baxter and Pine (1992) have been investigating science performance for several years, designing tests to foster good teaching and learning as well as to monitor student progress. Shavelson et al. (1994) were using alternative assessment technologies, consistent with the emerging constructivist assumptions about learning. One can say that these assumptions are surely correct for our target group, being adult students. Interesting feedback on student progress was supported by scoring the assessments so as to capture not just the right answer, but also the reasonableness of the procedure that was used to solve the problem (Shavelson, 1994).

Finally, the results of the 1992 study (Dochy, 1992) showed that there was a need for more formative evaluation during the study periods. These stipulations have led to work out so-called 'progress tests', consisting of items at final examination level. In this way, the progress tests give information on the discrepancy the students have to bridge in order to reach the final goals of the course(s).

Related to the overall-assessment prophecy (Dochy, 1992) and the use of progress tests, clearly an innovation can lead to interesting results. Snow (1990) states that new approaches to cognitive assessment in education should be directed towards initial states, daily skill and strategy transitions, weekly knowledge transitions or monthly progress in a course. Clearly, our earlier mentioned model of progress tests fits with Snow's last approach. There seems to be no doubt that such an innovative model is useful when looking at empirical research. Powell et al. (1990) comes to the following conclusions. Probably less than 10 percent of the students demonstrated sufficient progress to complete a multi-course program within a reasonable length of time. Moreover, 60 percent of first-time students fail to earn any credits within 30 months of being admitted. It seems clear that the problem cannot be handled by contracting students because nearly half of the students are unable (or perhaps unwilling at the moment) to state their study program intentions (Powell et al., 1990). This fits with the results of van der Velden et al. (1992), finding that only 16 percent of the students in distance education are interested in the advantages of such a study contract.

2.2.3 Assessment as an alternative support procedure

As stated above, other - formal - alternative examination provisions are not available in our university. But some 'informal' alternative formats, rather known as support devices, are present. For instance, the distance education study materials (mostly text-based) comprise a self-test and types of 'embedded support devices' (ESD) of an evaluative nature. A student can - but is not obliged to - make use of these text-embedded provisions and can read the written feedback at the end of each learning unit.

In a recent study - with a small sample of law students - the actual use of such embedded evaluative support provisions has been investigated (Poelmans et al, 1993). The findings show that questions, prequestions, tasks and feedback on tasks were used by at least 80% of the students. Moreover, 77% of the students, and in most cases up to 90% of the students, made a 'deep level' use of these provisions. Deep level use implies that the students extensively pay attention to the ESD, read them and react on them, let the ESD influence their study behaviour, etc. In terms of 'appreciation', the evaluative embedded support devices were part of a set of highest appreciated ESD.
In another 1992-study with Ou-students the evaluative support devices in the instructional materials were researched with a larger student population from different study domains (N=1907). This study revealed that 84% of the students solve more than 50% of the embedded questions and tasks (Boon et al., 1992).

These results suggest that students have a need for alternative assessment procedures that fit into their study approach, study plan, etc. Also it is suggested that the use of these assessment procedures is depending on the accessibility and easiness for daily use of these instruments. But study approaches differ and study plans represent a wide variety of strategies used by students. So, despite a rather 'general' demand for alternative assessment procedures, there remains the question about the adaptation of the alternative procedures to each students' study approach. About this topic, there is hardly information available in the context of distance education at the Dutch Open university. In this text we therefore pay much attention to such alternative evaluation procedures but link this immediately to the issue of student 'types'.

2.3 Students' views on innovative procedures

Concerning the students' views on our stated problem, a preliminary investigation was carried out by Dochy and Steenbakkers (1988) to search for an answer to a number of questions on the views of students about prior knowledge and the importance that prior knowledge has on learning.
In-depth telephone interviews were used and a sample of 120 Open University students were approached as respondents, divided among fields such as Economics, Natural Sciences and Social Sciences. This sort of interview uses pre-structured questions with open response options and can be regarded as a qualitative method of research, by Patton (1980) also as 'the standardized open-ended interview'.
Students were asked if they found the courses that they took related to their work / hobby / experience. Of the total research population one third of the students agreed that this was the case, although another third of the students thought there was no relation. In this last group there was clearly a majority of the so-called low-knowledge group (being students with only a few years work experience and no higher education degree).
Concerning the manner in which new knowledge can best be acquired, students still assign a dominant role in the transfer of knowledge to the school. When this is broken down into the HK and the LK groups, it appears that traditional views of the acquisition of knowledge are strongest among those with the most formal education. The LK group believes that it can also derive knowledge from self study and experience. Further, it was found that virtually every student thought that the effect of not having the 'prior knowledge' would be that the time required for the course takes longer. Another effect would be that where there was sufficient motivation and time, the course could be passed, but it would affect the course results i.e., a lower score would be achieved in the examination and it would be easier to fail.

These conclusions are consistent with the results of a study by Powell et al. (1991), investigating success and persistence at two distance teaching universities using questionnaires. Powell et al. found that the educational qualifications on entry of students of both universities were associated with success on the first course taken, with students having no post-secondary education performing worse than those with higher qualifications.
The study showed that pass rates of first-time students at both universities were remarkably similar at 36 percent. Pass rates for students who subsequently registered for more courses increased considerably as students progressed through their studies. Moreover, it was found that success on the first course taken is highly correlated with re-registration. Only 15 % of students who do not pass their initial course, return to take another.

2.4 'Types' of students : a rationale

As stated above, in this study about prior knowledge state tests and progress tests, much attention is being paid to 'types' of students. This interest in 'types' of students is an important topic in the general context of distance education: courses are to be multi-functional; 'clients' have very different backgrounds/profiles (educational level, professional background, study plan, study speed,...); etc.
The fact we concentrate so much on 'types' of students is the result of empirical, theoretical and pragmatic considerations:

- Institutional **research** with Ou-students (Boon et al, 1990) indicated e.g. the importance of variables such as educational background to explain differences in attitudes towards aspects of distance education. Our own earlier research in relation to prior knowledge research revealed that prior knowledge among students differs depending on their prior educational experiences, but only when we group students in two groups, being students with and without an university or higher vocational education degree (Dochy, 1992). Research in relation to the actual use of study materials reflect the impact of educational level, gender and study plan (Poelmans et al., 1993).
- At the **theoretical** level, student variables (independent variables), are incorporated in descriptive and explanatory theories or model about learning and teaching at the Open university (e.g. Valcke, et al., 1992; Vermunt, 1992).
- From a **pragmatic** point of view, taking account of student variables als answers a growing need to reach more efficient and effective education. There is for instance an urgent demand for more cost-effective planning and implementation of support and evaluative provisions; e.g. the number of study centres and study centre staff, the number of examinations taken by students,.... A key variable in this discussion is the 'type' of student for whom support and evaluative provisions in study centres are relevant and needed. The importance attached to the development of better intake-procedures is but one outcome of this general concern.

In this study we operationalise 'types' of students by making use of three variables :

- The level of **previous educational experiences**; we distinguish two groups of students, a group having higher education (higher vocational or university degree) and a group of students which highest previous educational experience is of secondary school level.
- The level of **success in studying** in the distance education setting of the Dutch Open university; here we distinguish between four groups of students based on the number of certificates: 0, 1-2, 3-4, and more than 4 certificates.
- The **content domain** according to the students' study plan; the Dutch open university distinguishes between the following 7 content domains: law, economics, business, technical, natural, cultural and social sciences.

One can question whether the three operational definitions of the variable 'student type' presented here are relevant and helpful to explain the way students react to evaluation formats. In our study, we do not neglect this question. More specific, we make use of log-linear analysis techniques to evaluate the impact of the independent variables when looking for grounds that account for the variance in student responses.

3. Research Design

3.1 Research hypotheses

Six clusters of hypotheses can be put forward taking account of the information obtained from the questionnaire (see appendix). The first four sets are related to prior knowledge state tests. The fifth is related to progress tests and the sixth set to study contracts:

a Students have no clear view of their prior knowledge level.
b Students do not need prior knowledge state tests.
c The perceived and expected effects of PKST on study variables are limited.
d The perceived effect of PKST on guidance, support is limited.
e Progress tests do not answer specific student needs.
f Study contracts do not answer specific student needs.

In the results section, each cluster hypothesis will be considered by relating the cluster to specific questionnaire items. In this way in-depth results are obtained which are helpful to draw detailed conclusions. The reader will notice that section f on 'study contracts' cannot be considered as an alternative evaluation format. As will be explained in section 4.3, we did incorporate this topic due to a animated discussion actually found at the Dutch Open university. We consider 'study contracts', in the context of this text, as a logical extension to the alternative evaluation formats put forward. In this way we want to know whether students are willing to attach formal consequences to the results of new evaluation formats. As indicated in section 2.2, the impact of the independent variable 'student type' will be researched in relation to each cluster of hypotheses.

3.2 Research Instrument

This investigation was designed in cooperation with the department for market research of our university. As part of their yearly research with a sample of students, the authors constructed a specific set of questions to be incorporated in a 17-page questionnaire (cf. appendix 1). The set of questions about prior knowledge state testing and progress tests made up one section in this questionnaire.
The items in the questionnaire mirror a specific set of research variables put forward about alternative assessment procedures. Each item can be consistently linked to such a variable. The construction of these items was not an evident task as will be outlined in the next paragraph.

If students have no prior experiences with the phenomena researched, how is it possible to get reliable and valid responses to question about these phenomena? The designing of a research instrument to get relevant information on opinions of students about the alternative assessment procedures researched here, is based on the assumption that students are not familiar with these alternative evaluation formats. Therefore the design of the instrument takes into account the pitfalls given by Neijens (1987) that can appear in the construction of an instrument for collecting informed opinions of a population. According to Neijens (1987) the four main indicators for the quality of the evaluated opinions are: direction errors, consistency errors, halo effects and judgement variation. Most of these can be avoided by providing correct information about the phenomena (and linking to their own experience) and by selecting carefully the presentation of the information.
First, in our design process, this solution was operationalised mirroring the alternative evaluation formats to aspects of the actual study process and study behaviour of the students. Secondly, in some cases several items were partly overlapping in order to control consistency. Thirdly, by gradually presenting to the students other aspects of the alternative evaluative procedures, in terms of inferences on aspects of their actual study behaviour and study process, more reliable information can be obtained about their appreciation, attitudes, acceptance of the new ideas. In this respect it is to be expected that students will show some so-called 'orientation behaviour' during the first questions. Example: Time planning of the study process towards the final examination is a normal aspect of student study behaviour. If we show to the students that progress testing can affect their normal time management, students can take positions on a better informed base. This example suggests that in constructing the questionnaire care has been taken to present to the students other specific implications, consequences and characteristics of the alternative evaluation formats. Another example is more complex. When testing e.g. the hypothesis "Students do not need prior knowledge state tests.", five items in the questionnaire were presented to the students, each of them presenting aspects that affect the study behaviour and study process:
- uncertainty about one mastery when starting a Ou-course
- time management

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- the way information obtained from prior knowledge profiles is to be used
- the need for personalised and written feedback
- the lack of feedback in current evaluation practices.

Despite the care taken in constructing the questionnaire, caution will still be needed when interpreting the research and when drawing conclusions. The data obtained from the students can still be biased by lack of information about and experience with the alternative evaluation formats.

As stated above, the questionnaire was carefully constructed by gradually adding specificity to the implications of alternative evaluation formats in terms of student behaviour and the study process:

- The questionnaire started with a descriptive text giving a short outline of 'prior knowledge' and 'prior knowledge state tests'.
- Next, questions were put forward about the students' perception, estimation of their personal prior knowledge state/level.
- After this, general questions were put forward about their willingness to take prior knowledge state tests.
- In the next questionnaire item, students could react to statements about possible uses that could be made with the results of the tests after deriving strong and weak points in one's prior knowledge state.
- The following set of questions repeated one by one possible uses of the prior knowledge state test results. Here, students could respond in a more elaborated way (5-point scale). Moreover, if relevant, an extra variable was added in these questions about the person to make 'use' of the information obtained: the student him/herself or advisors/experts.

The subsequent part of the questionnaire consisted of:

- a short introduction on progress tests
- and two questions about this evaluation format

The questionnaire ended with:

- a short explanation about study contracts
- and questions about the willingness of students to consider taking study contracts.

Also the questionnaire contained two questions about:

- feedback on the tests that are embedded in the course materials
- and the opinion of students about the feedback value of the actual Ou-examinations.

A first version of the questionnaire was screened by a team of educationalists and adapted following their comments. A second version was screened by the staff of the "Onderzoek & Evaluatie" department of the Dutch Open university. After revision, the final version was drawn up and incorporated in the larger questionnaire.

3.3 Research Population

An a-select sample of 2000 Ou-students was taken from the student population that subscribed for a course in the period September 1990 - September 1991 (N=35.313). This sample was stratified according to the variable 'success' in passing course modules. Of this sample, 1159 students responded by returning the questionnaire (58%). A weighting of the respondents was necessary taking the variables 'number of courses taken' and 'number of modules passed'. Every course exists of a certain number of modules depending on the study load of the course. Therefore, the modules give a more precise indication of a students' studyprogress. The results of the weighting procedure was a weighted number of 1907 students, each having passed the same amount of modules in a certain domain. As a matter of fact, in the following paragraphs n will always refer to this weighted number.

3.4 Procedure and data analysis

As stated above, the questions in relation to the alternative examination formats were part of a larger questionnaire. Early in 1992, the questionnaire was sent to the students. The extraction of the research data

from the questionnaire forms was done by staff of the department for market research. Further analysis was executed by means of a descriptive analysis of the answers on the questionnaire, a Chi-square analysis and log-linear analyses (table 1).

The Chi-square analysis of two-dimensional tables was executed to evaluate the independency of each specific student type variable from the large set of dependent variables as measured by specific (sets of) items in the questionnaire (1. prior educational level, 2. the degree of success in studying at a distance and 3. the content domain in which the students study). When we report in this text 'significant differences', this implies that the independence hypothesis is to be rejected. In reporting, we will then especially focus on those cells in the table that are particularly illustrative to base our conclusions in relation to the hypotheses put forward.
Next a log-linear analysis of the potential combined impact of two student type variables (previous educational experience and study success) was done to explain the data in the three-dimensional table (main effects and interaction effects); the analysis focused on a test of independence of the three variables in the analysis and took account of the first two student type variables as independent variables and the specific answer on a question as the dependent variable;
Finally, a hierarchical log-linear analysis explored what kind of model could best fit and significantly explain the data in the three-dimensional table. This final model is expected to be the simplest model explaining still the highest proportion of variance. The results of the analysis will only be used if the final model is different from the saturated model.

[Insert here table 1]

4 Research results

In this section, the results are discussed following the six clusters of hypotheses as discussed in part 3.1. In relation to each cluster, the way students responded to sets of questionnaire items are reviewed. At each level, descriptive statistics and the results of the Chi-square analysis are used. Results from the log-linear analysis and the hierarchical log-linear analysis are discussed separately and in view of the specific objectives of these analyses. In appendix I the reader can find the questionnaire with an overview of the student responses. The proportions reported in the tables are those resulting from the weighting procedure.

4.1 Prior knowledge state tests

4.1.1 Students have no clear view on their prior knowledge.

In relation to this hypothesis four items have been incorporated in the questionnaire:

a Did earlier Ou-courses you studied, build on wrong expectations about your prior knowledge level? *(variable = pkall).*

The results reveal that in the perception of most students (83.2%), the Ou-courses in general do not build on inaccurate expectations about ones prior knowledge level. This picture is not different for specific student types when taking account of prior educational level or the content domain they study. But, when comparing students with different degrees of study success in distance education, a significant difference emerges (χ^2=42.829 p.0000). It seems that especially the group of students who did not already obtain a Ou-certificate or only two certificates (51.3% of the respondents) indicates that they have no problem (90.8% to 90.2%). There is no independency between these variables. When students are more successful (3 to 4 certificates or more Ou-certificates) the proportion of students indicating they have no problem with prior knowledge drops to 79.1% and 73.4%.

b The course you actually study, does it build on prior knowledge you don't possess ? *(variable = pkthis).*

The results reveal that in the perception of most students (88.2%), the Ou-course they are actually studying does not build on inaccurate expectations about ones prior knowledge level.
A test of independence with each specific student type variable reveals that there might be an interaction with the content domain students study (χ^2=23.872 p.0006). The proportion of students indicating they have prior knowledge problems is extremely different when comparing natural science and business science students (23.5% compared to 8.4%).

c - What part of the course you actually study did you already master, taking account of your prior knowledge, when you started studying? *(variable name= pkbegin)*
- The impression about your initial mastery, based on your prior knowledge, could change when you started to study the course in detail. What part of the course did you finally estimate to master when you initiated your study of the actual course you have taken? *(variable name= pkafter)*

In this section we discuss the responses to two questionnaire items. Table 2 shows the proportions of the course the students estimate they already master as part of their prior knowledge at two different moments of the study process: before and during studying.The estimations of prior knowledge levels does not seem to differ depending on the two different moments. The following table repeats this information but reports more accurate data:

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Table 2: Estimation of prior knowledge before and during study

	0-9%	10-24%	25-49%	50-74%	75-89%	90-100%
before the study	*33.8%*	*36.1%*	*20.3%*	*6.3%*	*1.3%*	*0.2%*
during the study	*34.9%*	*38.2%*	*19.1%*	*6.4%*	*1.2%*	*0.2%*

When comparing the data in table 1, we hardly perceive differences. A χ^2-test confirms that there are no significant differences in proportions (χ^2 = .2354).
The comparison and the lack of differences questions the competence of the students to estimate their own prior knowledge state level. Next to comparing the outcomes at two estimation moments, one can ask whether the percentages in the table are not in conflict with the results obtained from earlier questions (section 4.1.1 b). For instance, up to 88.2% of the students indicate that while studying a specific course, the courses do not build on wrong expectations about one's prior knowledge. Once more these findings support earlier research results by Dochy (1992) sustaining the generally accepted statement that students are not able to estimate their own prior knowledge level (Falchikov & Boud, 1989).

4.1.2 Students do not need prior knowledge state tests

a I would like to get the opportunity to measure my prior knowledge state level before starting a Ou-course *(variable = wanttest)*.

This first question, helping to answer the above statement, already presents interesting results. At first sight, the proportions of students agreeing, disagreeing or reacting neutrally to the question are not extremely different: 35.5% of the students explicitly indicate they wish to know more about their prior knowledge state; 33.7% express a neutral attitude and 30.8% express a negative attitude. But, when we explore potential interrelations with student type variables, we discover significant differences for each of the three variables : educational level (χ^2=11.563 p.0030); study success (χ^2=117.37 p.0000); study domain (χ^2 40.285 p.0001).
Some striking differences were found. The number of students expressing a neutral or positive attitude is higher when the students have no higher educational background. The number of students in favour of prior knowledge state tests is extremely higher when we compare students without a Ou-certificate (44.0%), only up to two (32.9%) and more than 4 certificates (16.2%). Moreover, 50.2% of the latter group explicitly state that they do not want such tests.
Also, remarkable differences were found in student reactions depending on the study domain of students. Especially students studying natural (50.1%) and social (40.6%) sciences, express a need for prior knowledge state tests. Students studying law (35.5%) and economical (35.1%) express especially a negative attitude.

b How much time would you be willing to invest in prior knowledge state testing? *(variable = pktime)*.

Students studying in a distance education setting are sensitive to their time management and interferences in their time schedule. The time constraints they have to cope with in their particular study setting are not to be underestimated. It is therefore relevant ánd necessary to ask students about their willingness to invest time in services offered by the institution.
The latter is already obvious when we see that up to 29.4% of the students indicate right from the beginning that they do not want to spend time on solving a prior knowledge state test. This is in congruence with the proportion of students indicating they are not interested (30.8%) in prior knowledge state tests in the former section. For the further analyses we excluded this subgroup of students from the analysis.

The results show that the willingness to invest time is in general high if the test would last less than an hour and a half (59.6%). However, this pattern differs significantly if we take account of the student type variables. The proportion of students without a higher education experience that is willing to invest even

more than half an hour is significantly higher (19.5% compared to 10.9 %). The inverse is also true, students with a higher education background prefer to invest less time (66.3% compared to 60%). This is shown in Figure 6.

[insert here Figure 6]

Figure 6: Time investment in prior knowledge state tests; interaction with educational level

Also the degree of study success influences the pattern in student responses. If we compare students without a certificate with those with more than 4 certificates the pattern differences are evident. Among the former group the highest percentage is willing to spend between 30 and 90 minutes (67.1%). Among the latter 78.8% of the students are ready to invest up to 60 minutes for a test. This suggests that 'successful' students express a will to manage more strictly their available study time.

If we compare students according to the content domain they study, meaningful differences can be observed. It is for instance interesting to compare economics and natural science students in Figure 7. The highest proportion (40%) of economics students only wants to invest up to 30 minutes. The highest proportions of natural science students prefer an investment between 30 and 60 minutes. Striking is also that 28% of these students are willing to invest more than 90 minutes.

[Insert here Figure 7]

Figure 7: Time investment in prior knowledge state tests; interaction with study domains

c The information obtained during prior knowledge state testing could be represented with 'prior knowledge profiles' that reveal your weaknesses and strengths. What kind of use would you make of this information?

From the results of prior knowledge state tests, as stated earlier, profiles can be derived that reveal the weak and strong points in a students' prior knowledge. The general question above introduced, contains a list of ways the information from knowledge profiles could be used. In a way, the responses to this set of 'information uses' are helpful to determine whether the informative value of knowledge profiles can be considered as specific or as general.
Nine 'information uses' were put forward in the questionnaire. These nine can be clustered into three particular sets:

set 1: to direct content choices in relation to the study process (What do I already master about a course? What subparts of the course will I study more profoundly?);

set 2: to direct planning behaviour in relation to the study process (What course will I choose? How will I plan my study? What will be my study route? I will plan accordingly my examination in an earlier phase. I will study in a more rigid way.);

set 3: to ask for help, support (For what specific subparts will I call for help? To direct my demands for support.).

Figure 8 gives a general overview of the proportions of students in favour of these three sets of information use.

[Insert here Figure 8]

Figure 8: Informative value of prior knowledge profiles; % acceptance of three clusters

Asking students to react to the use of prior knowledge profiles to direct content choices (the first set) we observe high proportions of students preferring this type of information use:
- What do I already master of a course *(variable = infwhat)*? (51.4%)

- What subparts of the course will I study more profoundly *(variable = inftopics)*? (42.0%)

In relation to the first question "What do I already master of a course?", the answer pattern is significantly different considering all student type variables. Students with a higher education background, students with no Ou-certificate and students in specific content domains (business, economical, natural, social and technical sciences) especially stress this type of knowledge profile use.

Considering the second question "What subparts of the course will I study more profoundly?", the independency hypothesis is also rejected for the variables study success and study domain. There are for instance high proportions of students without a certificate (47.3%) and students studying natural sciences (55.8%) in favour of this information use.

The use of knowledge profiles to plan the study (second set) is also acknowledged by the students, but with varying degrees of enthusiasm (tabel 3).

Table 3: The use of knowledge profiles to plan the study

What course will I choose *(variable = infchoice)*?	48.0%
How will I plan my study *(variable = infplan)*?	40.9%
What will be my study route *(variable = infroute)*?	37.5%
I will plan accordingly my examination in an earlier phase *(variable = infexam)*.	28.0%
I will study in a more rigid way *(variable = infrigid)*.	26.5%

What is striking in this overview is that from the moment the type of information use affects a certain level of freedom and independence of the student, the students do no longer agree. From table 1 we can also derive that there are significant interactions with student type variables. The degree of success in studying interacts e.g. with the first question "What course will I study?". Students without a certificate agree with this type (55.2%) of information use. Students with more than 4 certificates strongly disagree with this kind of information use (71.6%).

The student type variable 'content domain' influences the response patterns for 4 of the five questions. We summarize this in table 4. This table shows for each subquestion the two groups with the highest proportions in favour of or pro a specific information use.

Table 4: Content domains and planning based on knowledge profiles

	pro
What course will I choose?	*T:41.9% L:43.8% E:57.2% N:60.7%*
How will I plan my study?	*L:32.6% C:33.6% S:46.1% N:57.4%*
I will plan accordingly my examination in an earlier phase.	*C:22% B:23.8% E:32% T:32.6%*
I will study in a more rigid way.	*C:18.5% N:21.7% E:32% T:32.2%*

T= Technical Sciences; N= Natural Sciences; L= Law; E= Economics; C= Cultural Sciences; B= Business Studies; S= Social Sciences

The use of knowledge profiles as a base to ask support/help (third set) is less preferred by the students. Only smaller proportions of student favour this kind of knowledge profile use:

Table 5: The use of knowledge profiles to ask for support/help

For what specific subparts will I call for help *(variable = infhelp)*?	25.4% help 1
To direct my demands for support *(variable = infsupport)*.	25.6% help 2

Moreover, and here there are striking differences, in relation to all student type variables there are significant interactions. Students with a higher educational background are e.g. less enthusiastic for the information use 'help' (18.0%) or 'support' (20.1%), compared to students with a lower educational background: 'help' (32.9%), 'support' (31.9%).
The proportions of students in favour of these kinds of knowledge profile use are also significantly different when we consider the independent variable 'study success'. We compare e.g. the proportions of students who respond positively according to the number of Ou-certificates the students already gained. The more certificates acquired, the less enthusiasm can be perceived for help- and/or support-functions.

Table 6: The use of knowledge profiles to ask for help for different students

	0 cert.	*1-2 cert.*	*3-4 cert.*	*>4 cert.*
asking for help	*29.5%*	*25.1%*	*17.7%*	*16.1%*
asking for support	*28.4%*	*24.9%*	*18.2%*	*21.4%*

Considering the third independent variable 'content domain', there are also striking differences in proportions in favour or against this kind of knowledge profile use. If we simply consider the data in the next table we see that consistently the same content domains display the highest pro reactions:

Table 7: The use of knowledge profiles to ask for help in different domains

	pro
asking for help	*B:17.2% T:23% E:35.4% S:36.4%*
asking for support	*B:17% T:26.1% S:31.7% E:36.6%*

T= Technical Sciences; N= Natural Sciences; L= Law; E= Economics; C= Cultural Sciences; B= Business Studies; S= Social Sciences

d Personalised and written feedback in relation to self-tests should be a valuable option. *(variable = selftest)*

The potential of prior knowledge profiles is that students can get personal or written feedback. 63.8% of the students indicate they would appreciate this kind of feedback. Only 11.5% is not interested in this provision. Further analysis reveals that certain student type variables influence the response pattern of the students. The number of students depreciating this provision is for instance higher when the students have a higher education background (15.7% compared to 6.5%).
The same pattern can be found if we compare students having as yet no Ou-certificate (6.0%) and students who already obtained more than 4 certificates. 28.3% of the latter group does not like this extra provision. Considering the content domain the students are studying, there are significant differences in the proportions of students agreeing or disagreeing, but the overall number of students showing a positive attitude is for all content domains more than 57.6% with a maximum of 68.7% (social sciences).

e When taking examination at the Ou, I learn very little from the feedback or information in relation to my errors. *(variable = exam).*

This item is not immediately linked to the topic 'prior knowledge state tests', but - in our perception - results in relation with this item bring further evidence for a testing practice, resulting in more relevant informative feedback. Moreover, the topic is linked to the 'feedback'-issue tackled in the former section. These students could agree, disagree or react neutrally to the following statement:
"I learn little from my final examination. I get too little feedback or information in relation to wrong answers or solutions." The students react in the following way (N=1839) (table 8).

Table 8: Learning very little from the feedback on examinations

I disagree	*16.8%*
neutral	*44.7%*
I agree	*38.4%*

From Table 1 we can derive that student reactions interact with all student type variables (χ^2).
For instance, students without a higher education background (41.5% agree, 13.8% disagree) express in a more explicit way their agreement than students with a higher education background (36.9% agree, 18.8% disagree). Study success as expected interacts extremely with students opinion about the feedback value of current Ou-examination.

Table 9: Appreciation of the current feedback practice ; interaction with the number of certificates

number of certificates	*% agreement*	*% disagreement*
0	*23.6*	*12.8*
1-2	*58.1*	*16.3*
3-4	*54.8*	*22.9*
>4	*51.2*	*26.3*

Also the interaction with the content domain the students study is significant; cf. Figure 22. Disagreement is the highest within students studying technical (24.9%), economical (21.0%) and law sciences (20.0%). Agreement is high within students studying law (44.5%), social (43.5%) and business sciences (40.7%).

4.1.3 The perceived and expected effects of prior knowledge measurement on study variables are limited

a Prior knowledge has an effect on 'selectivity' in study behaviour.

Students could, in relation to this hypothesis, react upon two questionnaire items. The first item builds on the condition where students themselves estimate their own prior knowledge level. The second item builds on information that could be provided to the students as a result of prior knowledge state tests and prior knowledge profiles.

Table 10: Prior knowledge and selectivity in study behaviour

	I agree	*neutral*	*I disagree*
I concentrate on course parts that are new to me (variable = pkselect)	*39.3%*	*39.7%*	*21.1%*
I would select course parts to be studied more thoroughly for the final examination (variable = choice)	*46.4%*	*30.8%*	*22.8%*

The percentages suggest that prior knowledge measurement could influence selectivity in study behaviour. In relation to the first statement, student reactions interact with two independent variables 'educational level' and 'study domain'. The proportion of students concentrating on new parts as a consequence of estimated prior knowledge state levels, is higher when the students have a higher education background. Especially students studying economical sciences (51, 9%) and technical sciences (51, 7%) agree with this statement.

But reactions to the second statement are also interrelated with student variables. Striking is for instance the difference in proportions of students agreeing when we distinguish students without certificates (50.6%) versus students with more than 4 certificates (34.8%).

Natural sciences (29.5%) and business sciences students (28.5%) react most negatively, whereas the proportions of students with a positive attitude are the highest among technical sciences (48.2%) social sciences (47.4%) and law sciences (47.5%) students.

b The information acquired from prior knowledge state tests can influence study time management.

Two questions in the questionnaire asked whether students would change their study speed when they got information about their prior knowledge state level.

Table 11: Prior knowledge state tests and study time management

	I agree	*neutral*	*I disagree*
I would take examination earlier (variable = quicker)	*34.1%*	*39.6%*	*26.3%*
	Yes	*No*	
I would plan in a more rigid way my study (variable = infrigid)	*26.5%*	*73.5%*	

The data in the table are interesting. At first sight a contradiction in the response behaviour of the student is suggested by the very different proportions of students reacting negatively. But, both statements ask students to react to different aspects of study time management:
the first statement leaves all autonomy to the student to determine the moment to take an examination. A certain proportion of students would be willing to do this (34.1%).
The second statement asks for an attitude towards a more drastic, long-term aspect of time management. Here we perceive an extremely negative attitude towards such kind of time management planning. 73.5% of the students reject this option.
The data in the table get even more interesting when we research significant interactions with student type variables. Study success and study domain influence responses to the first statement. Experienced students with more than 4 certificates (33.9%) react e.g. more negatively than students without a certificate (24.5%).

In contrast, the proportions switch when we look at the proportions of students in favour of the option offered: the proportion of experienced students drops to 24.2% but the proportion of students without certificate raises to 36.6%. Students studying social sciences (37.3%) and technical sciences (43.2%) are more positive towards this type of time management whereas law students (31.7%) and economics students (42.1%) express the highest proportions of negative attitudes.

In relation to the second statement there is only a significant interaction with the study domain: cultural sciences (81.5%) students and natural sciences (79.3%) students react much more negatively. Technical sciences (32.3%) and economics sciences (30.2%) students react more positively.

c. Considering the potential of the technological evolution, it is possible to present individual students a specific printed version of a course. Such an individualised print-out, matched to my prior knowledge and experience, is a good option. *(variable name= print)*

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If recent technological developments were used to derive from prior knowledge measurement a 'tailored course' by printing an adapted version of the course, students do not express an extremely negative (36.5%), neutral (33.0%) or positive attitude (30.5%).

But this global picture changes when we perceive significant interrelations between response behaviour and all the student type variables (table 12).

Table 12: Students' perceptions on using inidividual printed courses matched to their prior knowledge

	I disagree	*I agree*
No higher education background	*32.6%*	*34.3%*
Higher education background	*41.7%*	*26.4%*
No certificate	*32.7%*	*35.1%*
> 4 certificates	*45.9%*	*21.0%*
Business sciences	*42.7%*	*26.8%*
Natural sciences	*32.4%*	*37.0%*

The first two variables indicate that experienced students reject more readily this possibility.

d. Students with a good portion of prior knowledge in a certain content domain should get the opportunity to follow a suited study route. *(variable name= route)*

At this moment students, taking courses from a diploma line have to take a standard number and/or elaborated set of courses. When asked to react to this statement, we can measure to what extent students wish to get adapted study routes (e.g. shorter).

[Insert here figure 9]

Figure 9: Prior knowledge state and study route; interaction with study domain

The proportion of students in favour of this possibility is very high (62.4%). And in line with expectations there are significant interactions with student type variables: study success and study domain. Although more than 50% of all students is in favour of this option, we see that students without a certificate show rather extreme positive reactions (66.0%) than students with more than 4 certificates (50.5%).

When controlling for the domain the students study, as shown in figure 9, we perceive an extremely positive attitude of students studying natural sciences (70.5%), social sciences (69.2%) and technical sciences (69.3%).

e. When studying my course, I need a tool to determine - on my own - how good I already master the course-content. *(variable name= mastery)*

72.5 % of the students accept this statement. Only 7.7% reject it. This attitude clearly indicates the need of students to have more information about their study progress.
The significant interactions in student responses with student type variables do not change this picture. They only reveal that e.g. students with no higher education background (76.8%) do express this need to a higher extent than those with a higher education background (68.4%).

A comparable interaction is perceived when controlling for the number of certificates: students without

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certificate (76.3%) are more positive towards the statement than students with more than 4 certificates (60.9%).

[Insert here Figure 10]

Figure 10: Prior knowledge tests: a tool to control mastery of the study process; interaction with study domains

The significant interaction with study domain is especially due to the different proportions in favour of the statement among natural sciences students (79.6%) and economics sciences students (65.5%).

4.1.4 The perceived effect of PKST on guidance, support is limited

Three questions in the questionnaire measured the extent the students were willing to accept guidance or support based on the results of prior knowledge state measurement. We summarize the results in table 13.

Table 13: Perceived effect of prior knowledge state tests

	No	*Yes*
1. I would use information on my prior knowledge to direct my demand for support (variable = infsupport).	*74.4%*	*25.6%*
2. I would use information on my prior knowledge to ask for help from a student tutor (variable = infhelp).	*74.6%*	*25.4%*

	I disagree	*Neutral*	*I agree*
3. I would use the information to ask advise from experts in relation to the parts I have to study (variable = advise)	*35.6%*	*32.1%*	*32.3%*

Making use of a third party to direct one's own study does not seem to be an attractive option to most students. The high percentages of 'no' reaction support this conclusion.
From Table 1 we learn that the way students react is also significantly influenced by the three independent variables: educational level, study success and study domain. The following 2 figures depict these interactions.

[Insert here Figure 11]

Figure 11: Prior knowledge and help/support; interaction with student type variables

[Insert here Figure 12]

Figure 12: Prior knowledge state tests; advise from experts, interaction with student type variables

For example, the proportion of students in favour of the three statements is always higher among students without a higher education background than among students with this background. Secondly, when comparing students without a certificate and those with more than four such certificates the same consistent picture can be perceived: the proportion of students without a certificate in favour of the statement is always higher than the proportion of students with more than 4 certificates in favour of the idea. Thirdly, checking for the variable 'study domain', reveals that the proportions of students taking courses in economics sciences and social sciences,which are in favour of the idea,are much higher than the group of favourable students who follow courses in other content domains.

4.1.5 Log-linear results

As stated in section 3.4, we incorporated in our analysis techniques log-linear and hierarchical log-linear analyses for a specific purpose. In contrast to the χ^2-technique we try to check to what extent two of the three independent variables also play a combined effect to explain the specific data-structure in the three-dimensional table. We repeat that:
- our log-linear analysis focuses on a test of independence of the three variables in the analysis and takes account of the first two student type variables as independent variables and the specific answer on a questionnaire item as the dependent variable;
- the hierarchical log-linear analysis explores what kind of model can explain the data in the three-dimensional table. This model is expected to be the simplest model explaining still the highest proportion of variance.

Table 1 summarizes the results of these analyses (G^2 and p-values). We focus in this section only on the analyses in relation to prior knowledge state tests. The test of independence of the three variables in the model is highly informative. In relation to most dependent variables about prior knowledge tests we perceive that the independency hypothesis is to be rejected ($p < .01$). This confirms the results of the two-dimensional χ^2-tests. Example: analysis of the results for the question whether students want prior knowledge state tests *(variable = wanttest)* reveal a very significant G^2-value ($p = 5.E\text{-}21$). We can read in the three first columns, the very significant results of the chi-square analyses; each independent variable interacts with student response behaviour. The log-linear analysis adds to this that it might be possible that a combined effect of the two independent variables 'study success' and 'educational level' influences the response pattern. Very significant p-values are indicative of this possible phenomenon. The hierarchical log-linear analysis confirms this - to a high extent - since the final model contains the interaction between *wanttest* x educational level and the interaction between *wanttest* x study success. This finding is a first indication that the independent variables 'educational level' and 'study success' are useful operational definitions of the variable 'student type'. Of high importance is the fact that the interaction of both independent variables (educational level x study success) is not a part of the final model.

The table also shows three examples of models containing third-order interactions: the variables *pkthis, pkall* and *pkafter*. In these three cases, the final model contains also the third-order interaction between the two independent variables (IV_1 and IV_2) and the dependent variable (DV) and all second-order interactions and main effects of the single variables:

$$(IV_1 \times IV_2 \times DV) + (IV_1 \times DV) + (IV_2 \times DV) + (IV_1 \times IV_2) + IV_1 + IV_2 + DV.$$

This finding does indicate that for these three dependent variables the impact of each single independent variable or their interaction with the DV is not enough to account for high proportions of the variance. But, it is remarkable that these three dependent variables are linked to the first questions in the questionnaire. This could suggest that students were still orienting themselves towards the topic 'prior knowledge state tests' when responding to these items. The impact of background variables could be overruled by this 'orientation behaviour'.

In relation to three variables the independency hypothesis is not rejected for the log-linear analysis: *infplan, infexam* and *infrigid*. Here we perceive in the final model, after a hierarchical log-linear analysis, that only main effects of the variables in the model are retained to account for the highest proportion of variance. The single effect of each independent variable is always retained in the final model, thus giving extra support to our earlier statement that these IV can be considered as good operational definitions of the general variable 'student type'.

In general, the results of the log-linear and hierarchical log-linear analysis confirm the results obtained from the χ^2-analyses. But they add an extra dimension to these results by indicating that the discrete independent variables 'educational level' and 'study success' are each but part of a complex set of possible operationalisations of the concept 'student type'. Two-way interactions and even three-way interactions

also play a part. But, taking account of the high level of agreement between the χ^2-results and the results form the log-linear analyses, the results indicate that the two independent variables in our models are already useful and relevant operational conceptions of the complex variable 'student type'.

4.2 Progress tests do not answer specific student needs

This hypothesis about progress tests has been split up into two subhypotheses:

4.2.1 The possibility for students to determine study progress by making use of progress tests is an option to be offered. *(variable name= wish)*

Table 14: Using progress tests

I agree	*75.3%*
I disagree	*7.8%*
Neutral	*16.9%*

The results in the table 14 hardly need further comments. This could be predicted from the way students reacted to the statement in section c.5. There is also a significant interaction with each of the three student type variables. The difference between the proportion of student in favour of progress tests with higher education (70.4%) and without higher education (79.5%) is already remarkable. But, if we compare proportions of students in favour of progress tests without a certificate (83.0%) and with more than 4 certificates (55.2%) the difference becomes even more striking.

Thirdly, the content domain the students study also plays a role: Business sciences students (10.3%) and law sciences students (10.6%) are much more against the idea of progress tests than students studying other domains, whereas the proportion of students in favour of the idea and studying natural sciences (88.6%) is up to 10% higher than students in other domains.

4.2.2 To get regularly the possibility to take progress tests would be helpful to structure my study in time and to take examination much earlier. *(variable name= regular)*

Only one question of the questionnaire evaluated the potential impact of progress test measurement on study behaviour. With 55.7% pro and 17.1 % against the idea of making use of progress tests to adapt ones study time management, progress seem to answer a certain need of students.
That this 'need' is different between students can be derived from the chi-square results. Students without higher education background (79.5%) are more positive towards the idea than students with a higher education background (70.4%). If we compare proportions of students in favour of but without a certificate (67.6%) or with more than 4 certificates (33.0%) the difference becomes even more striking.

Students taking courses in cultural sciences (58.1%) and social sciences (58.7%) are to a higher extent in favour of time management based on progress tests than students studying other domains.

4.2.3 Log-linear results

The discussion presented in 4.1.5 can be repeated in relation to student opinions and reactions in relation to progress tests:
Firstly, the results support the findings of the χ^2-analyses. The independency hypothesis is to be rejected. There is an interaction between the student responses to progress tests and the two independent variables 'educational level' and 'study success'.

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Secondly, the analyses confirm that the independent variables are useful operational definitions of the general variable 'student type'. Both variables *wish, and regular*, in interaction with the independent variables, are retained in the final model after hierarchical log-linear analysis. No three-way interactions are observed.

4.3 Study contracts do not answer specific student needs.

As stated in section 3.1, study contracts do not represent an alternative evaluative format. We have incorporated this subject as a logical extension to the alternative evaluation formats 'prior knowledge state tests' and 'progress tests' in order to get extra information on the students' views about the consequences they are willing to attach to the results of new evaluation formats. Actually, at the Dutch Open university, there is a vivid interest in study contracts as a way to strengthen the institute-student link, assuming a better and higher degree of students taking follow-up courses (Van der Velden, et al., 1992). Part of the potential content of a study contract could be related to (formal) use of evaluation results.

4.3.1 After getting info about my prior knowledge and advices based on it, I would be prepared to discuss with the to make a 'contract' about my study route and study planning. *(variable name = contract)*

32.7 % of the students accept the idea of 'study contracts', 45.4% reject the idea and 22.0% express a neutral attitude. Acceptance or rejectance is significantly influenced by the three student type variables. Figure 40 depicts the impact of 'educational level' and 'study success'. The negative attitude is for instance much higher among students with a higher education background (52.5%) than among students without this educational experience (39.0%).

Also the variable study success plays a comparable role: students without certificates are much more in favour (35.9%) or less against (41.5%) than those with already more than 4 certificates (29.3% in favour, 53.5% against).
As to the variable 'study domain', students studying business sciences (52.5%) and economical sciences (49.0%) are much more against study contracts than those taking courses in other domains:

The proportion of students in favour of this potential initiative is higher among the law sciences (33.2%), social sciences (39.9%) and technical sciences (33.2%) compared to students studying other content domains.

4.3.2 Log-linear analysis

Again, the discussion presented in 4.1.5 can be repeated here as we already did in section 4.2.3:
First of all, the log-linear analysis results support the findings of the χ^2-analysis. The independency hypothesis is rejected. There is an interaction between the student responses to study contracts and the two independent variables 'educational level' and 'study success'.
Second, the analysis confirms that the independent variables are useful operational definitions of the general variable 'student type'. Both variables 'wish' and 'regular', in interaction with the independent variables, are retained in the final model after hierarchical log-linear analysis. No three-way interactions are observed.

5 Discussion

In discussing the results reported above, we will structure the discussion according to the six sets of hypotheses as stated earlier. But, considering some particularities of the response behaviour of the students, we start the discussion with some general reflections.

5.1 Responding to the questionnaire: a learning process

When examining the construction of our questionnaire we stressed complicating issues that could interfere with the response behaviour of the students since they are asked to react on evaluation formats they are not acquainted with. The solution to this problem was a careful construction of the questionnaire by gradually presenting to the students very specific potential implications/consequences of alternative evaluation formats. This brings about that the students gradually are introduced to a fuller picture of these alternative evaluation approaches and that their initial responses to questions can be - from this point of view - different from those at the end of the questionnaire. We could, if the latter is true, for instance expect that the students take more and more extreme positions towards the items presented at the beginning or end of the questionnaire. A quick glance at the response patterns in the tables of appendix I shows that this is not the case. The opinions vary, the proportions of neutral, positive or negative responses switch from item to item. Moreover, and this will be illustrated in the next sections, the response pattern is rather consistent when comparable implications/consequences are presented to the students.

Nevertheless, a certain 'learning process' could yet be observed when analyzing the students responses. We already referred to it in dealing with the log-linear results about prior knowledge state tests. There we found three-way interactions between the dependent and independent variables to be able to account for variance in the three-dimensional matrix, and this in relation to some initial items in the questionnaire. We tried to explain this by suggesting that the students were still orienting themselves towards the topic 'prior knowledge state tests' when responding to these items. The impact of background variables could be overruled by this 'orientation behaviour'.

5.2 Prior knowledge state tests

Four main hypotheses were put forward in relation to prior knowledge state testing. The results of each of these will be discussed in relation to the theoretical background and earlier empirical findings.

5.2.1 Students have no clear view of their prior knowledge level.

The information in the results section, based on the reactions of student to three items, is helpful to accept or reject this hypothesis.
First of all it is remarkable that in general, students indicate no major problems in relation to courses wich would build on wrong expectations about their prior knowledge. This could suggest that students are not aware of mismatches between course content and their prior experiences/knowledge.
But this is countered by various tests of independence with independent variables. We perceive for instance a very logical and coherent pattern in the way students who already acquired more certificates react to these items. These more experienced students take second-level and/or third level courses and enter domains for which they have less prior knowledge. As a result it is logical that they mention higher degrees of mismatches between their prior knowledge state level and the course content elaboration.
Also interesting in this context is the fact that students taking courses in study domains that build on very explicit prior knowledge mention proportionally higher degrees of prior knowledge problems; a typical example is the study domain natural sciences. The coherence and nature of the findings discussed here give us not enough grounds to reject this first hypothesis in relation to prior knowledge state tests.

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The fact that past research has shown that students are not able to rate their own level of prior knowledge (Falchikow & Boud, 1989; Wagemans, et al., 1991; Dochy, 1992) can be sustained. Moreover, an important finding is that general aspects such as the domain of study provides interesting information. This investigation shows several times that prior knowledge and its use is domain-specific (Alexander, 1992; Dochy, 1992).

5.2.2 Students do not need prior knowledge state tests.

Five items in the questionnaire were presented to the students to be able to test this hypothesis. Prior knowledge testing was presented as affecting the following study behaviour and study process aspects:
- uncertainty about one mastery when starting a course
- time management
- the way information obtained from prior knowledge profiles is to be used
- the need for personalised and written feedback
- the lack of feedback in current evaluation practices

Generally, it can be concluded that there is a need for prior knowledge state testing, i.e. 69.2% of all respondents don't have any objections. Interesting is that this need is concentrated within certain subsamples, being students with lower educational background and students without and with no more than two certificates. Also interesting is that the nature of the domain plays a role in this: for example 50% of all students in natural sciences is in favour.

Striking is that most students in favour of prior knowledge testing do prefer to spend considerable time on this: one hour and a half. This time management should be seen in the light of prior educational experience: students with higher education experience do want to spend less, those without higher education experience want to spend more time. Also, the less certificates a students has, the more time he wants to invest.

Concerning the use of information obtained from knowledge profiles, three types of use were selected: to direct content choices, to plan the study process, to ask for help and support.
Half of the students do want to know what they already master from a particular course. Students with a higher education background, students with no certificate and students studying business studies, economics, natural, social and technical sciences especially stress this type of knowledge profile use.
Knowledge profile use in order to plan the study is not that popular, except for choosing courses (48%) and for students with no certificates (55.2%).
Knowledge profile use as a base for support is also particularly requested by students with no higher education experience and without any certificates.

An advantage of the use of knowledge profiles is that students receive personalised and written feedback, a service that is highly welcomed by students. Only 11.5% of the students is not interested in this provision, being students with a higher education background and with several certificates. Students generally find that there is a lack of feedback when talking about the current examinations. The more exams a student takes, the more need for specific feedback.

Apart from the view and utility on the different functions of knowledge profiles, the variables that are of prime importance are stressed. As shown earlier by Dochy & Steenbakkers (1988) and Dochy (1992), previous educational level operationalised as having 'higher education' or 'no higher education' is a significant variable. Next, as earlier shown by Alexander (1990) and many others (for an overview, see Dochy, 1992) using prior knowledge is domain-specific. The variable 'domain' seems to be of importance. Finally, study success expressed as an amount of certificates is significant as found earlier by Powell et al. (1990).

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5.2.3 The perceived and expected effects of PKST on study variables are limited.

The results show evidence to reject this hypothesis. Related to our second statement related to information that could be provided to students as a result of PKST, 77.2 % of the students say not to disagree with the fact that they would select parts of the course to be studied more thoroughly. This would even be used more by students with a higher education background.

Related to their time management, as expected on the earlier stated literature, students do not want an intervention in their long-term time-management. However, when the autonomy is left to the student, he might use a provision (such as PKST) in order to take an examination earlier (73.7%). Also this fact differs for domains and amount of certificates.

Finally, a tailored course matched to one's prior knowledge is acceptable for 69.5% of the students, being mainly students with no higher education background and no certificates yet.
Students are also in favour of specific study-routes when having high prior knowledge.

5.2.4 The perceived effect of PKST on guidance, support is limited.

This hypothesis can be confirmed. A larger proportion of the sample does not express a positive answer to these questions. This is also in line with earlier research (Powell, Dochy) which shows that involving 'a third party' for support is not well appreciated by students. The 25% up to 32 % of the sample in favour of a third person for guidance are clearly also those students having no higher education experience and having no certificates up till now.
These results are consistent with earlier research. Boon et al (1990, p.31) discovered e.g. that 70% of a sample of students (N=1123) prefer the actual educational system with much freedom or even more freedom instead of a system with restrictive aspects. Important in their results was the fact that students sometimes expect more provisions, but objected against shortcutting of their freedom as a consequence of these provisions (p.30).

5.3 Progress tests and study contracts

a Progress tests do not answer specific student needs.

In answer to the question if students need a tool to determine themselves how good they master the content, 92.3% replies that it is the case. This clearly shows an extremely positive attitude towards progress tests and confirms the findings of earlier research as given in the introductory part. The few students that do not want this are in the camp of higher education background and more than 4 certificates. A second, but direct question concerning the use of progress tests reveals exactly the same results (7.8% against). Differences between several groups are rather small, except for differences in domain (deviation of 10%).

Apart from this positive result, with 55.7% pro and only 17.1% against, the idea of using progress tests to adapt ones study time management seels to answer a real need of students.
Since progress is shown to be one of the major problems in distance education (e.g. Powell, 1991; Dochy, 1992), the implementation of progress tests could probably provide a solution.

b Study contracts do not answer specific student needs.

Since it is clear that students cannot estimate their own prior knowledge level, the fact that students do not like interventions in their time-management from a third party (this investigation) and are not able to state their own study program intentions (Powell, 1991), it is expected that this hypothesis cannot be rejected. This seems to be the case. In congruence with the finding of Van der Velden et al.(1992) that only 16% of the students is interested in study contracts, we found 32.7% of the students accept the idea, but 45.4%

reject it. Striking is that students in business sciences and economics are even more against study contracts.

6 Conclusions

This investigation stresses the findings of earlier research and shows that development of concrete instruments can lead to a considerable use by the students. Overall, one can say that there is a realistic need for prior knowledge and progress testing and that this will lead to better study results and a higher through-flow of students. Prerequisite is that the correct variables are taken into account.

Students are not able to estimate their own entry level, however there is a need for assessment of prior knowledge and a translation into knowledge profiles. For a majority of the students the individual and specific feedback from knowledge profiles is highly necessary and students are willing to invest considerable time. This information will be used for making content choices, for planing the study process and as a basis for support. Hence, several variables have shown to be very useful for differentiating between groups and between functions of knowledge profiles. These variables are: previous educational level (higher or no higher education), domain and study success (amount of certificates). These results are confirmed and corroborated in our log-linear analyses.

The study shows that students do not want any interference in their time-management (e.g. by tutors) but providing them with tools to monitor their entry-level and progress could lead to a faster study-route. Students do favour new tools as tailored courses and study-routes, adapted to individual knowledge profiles. Extremely high is the expressed need for a tool such as progress tests. These have also a much better chance for influencing the pace of studying, rather than study contracts which are much less acceptable for students.

This investigation shows that the development of alternative assessment procedures will be better accepted as a basis for study-support (as shown in the earlier teaching-learning model) than traditional human support. Moreover, the different functions it can serve for different groups is larger, and when taking account of the main variables large groups of students can get a better through-flow.

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Table 1: Overview of Chi-Square analysis and log-linear analyses

DV Dependent Variable	DV x IV¹ Educ. Level (1,2)		DV x IV² Study Success (1,4)		DV x IV³ Study Domain (1,7)		Log-linear analysis DV by IV¹ IV²		Hierarchical Log-linear analysis (G^2)		Final model(s)
	χ^2	$p_{\chi 2}$	χ^2	$p_{\chi 2}$	χ^2	$p_{\chi 2}$	G^20	p_{G2}	G^20	p_{G2}	
pkthis	2.394	.1408	7.287	.0633	23.872	.0006	17.984	.012	.0000	1.000	pkthis x level x success
pkall	4.498	.1055	42.829	.0000	19.472	.0788	67.896	5.E-09	.0000	1.000	pkall x level x success
pkselect	32.522	.0000	6.901	.3301	41.203	.0000	49.912	.0000	20.609	.150	pkselect x level / success
pkbegin	14.272	.0140	37.227	.0012	100.888	.0000	75.886	.000	21.569	.252	pkbegin x success / pkbegin x level
pkafter	26.017	.0001	31.581	.0073	110.857	.0000	87.832	.000	.0000	1.000	pkafter x level x success
wanttest	11.563	.0030	117.372	.0000	40.285	.0001	130.788	5.E-21	9.918	.357	wanttest x level / wanttest x success
pktime	28.046	.0001	128.428	.0000	123.822	.0000	161.904	4.E-15	21.121	.452	pktime x level / pktime x success
infwhat	14.681	.0001	38.153	.0000	33.505	.0000	54.879	2.E-09	4.151	.656	infwhat x level / infwhat x success
infchoice	3.517	.0607	85.601	.0000	20.138	.0026	92.522	4.E-17	6.482	.485	infchoice x success / level
infplan	.25565	.6131	7.371	.0609	32.807	.0000	8.181	.317	10.865	.368	level / infplan / success
infroute	1.910	.1669	6.162	.1040	12.483	.0520	13.463	.062	6.944	.435	infroute x success / level
infexam	.00196	.9647	6.6929	.0824	15.202	.0183	6.100	.528	8.785	.553	level / infexam / success
infrigid	.2578	.6116	.11878	.9895	17.360	.0080	5.359	.616	8.043	.625	infrigid / level / success
inftopics	.13563	.7127	35.903	.0000	16.745	.0103	38.388	.000	5.046	.654	inftopics x success / level
infsupport	31.427	.0000	12.782	.0051	37.479	.0000	48.244	.000	6.592	.360	infsupport x success / infsupport x level
infhelp	50.758	.0000	28.987	.0000	48.254	.0000	83.660	2.E-15	7.935	.243	infhelp x level / infhelp x success
choice	4.3129	.1157	27.991	.0001	35.806	.0003	41.539	.000	17.221	.102	choice x success / level
advise	75.128	.0000	51.558	.0000	36.948	.0002	122.010	3.E-19	2.133	.989	advise x level / advise x success
quicker	2.9602	.2276	19.487	.0034	79.900	.0000	26.865	.020	7.358	.769	quicker x success / level
print	18.352	.0001	29.827	.0000	27.156	.0073	51.511	.000	6.148	.725	print x level / print x success
route	6.3388	.0420	25.9436	.0002	35.536	.0004	46.203	.000	11.128	.267	route x level / route x success
support	11.948	.0025	30.1234	.0000	24.981	.0149	40.395	.000	6.493	.690	support x level / support x success
maserys	17.763	.0001	43.365	.0000	33.131	.0009	62.604	.000	8.701	.465	mastery x level / mastery x success
wish	29.640	.0000	138.084	.0000	29.817	.0030	149.150	1.E-24	7.771	.557	wish x level / wish x success
regular	41.568	.0000	200.964	.0000	17.725	.1243	232.608	.000	5.200	.817	regular x level / regular x success
exam	8.561	.0138	301.178	.0000	37.967	.0002	317.363	.000	11.928	.064	exam x level / exam x success / level x success
selftest	37.796	.0000	121.141	.0000	27.778	.0060	154.120	.000	.0000	1.000	selftest x level x success
contract	31.816	.0000	25.081	.0003	41.802	.0000	61.587	.000	13.429	.144	contract x level / contract x success

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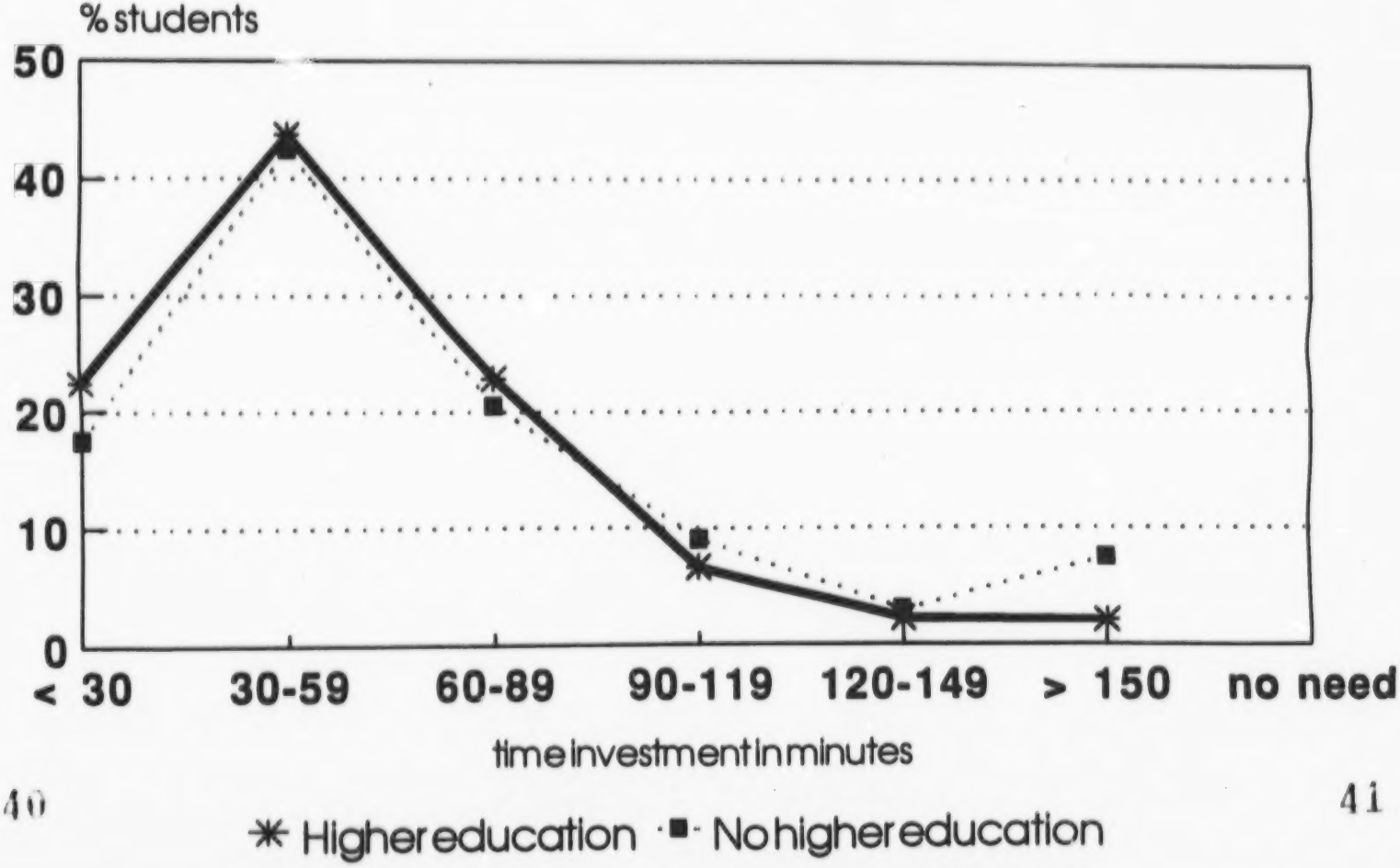
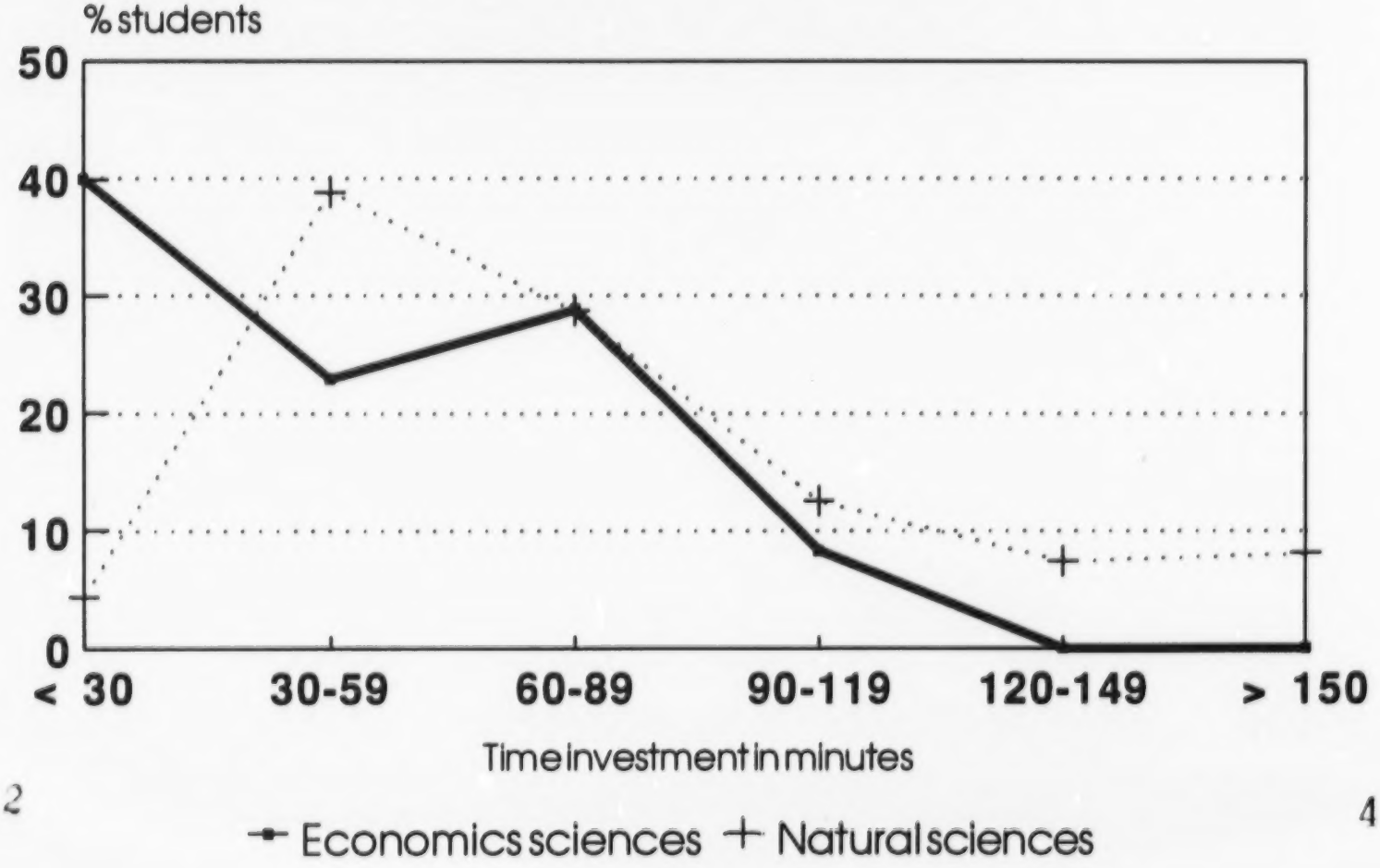
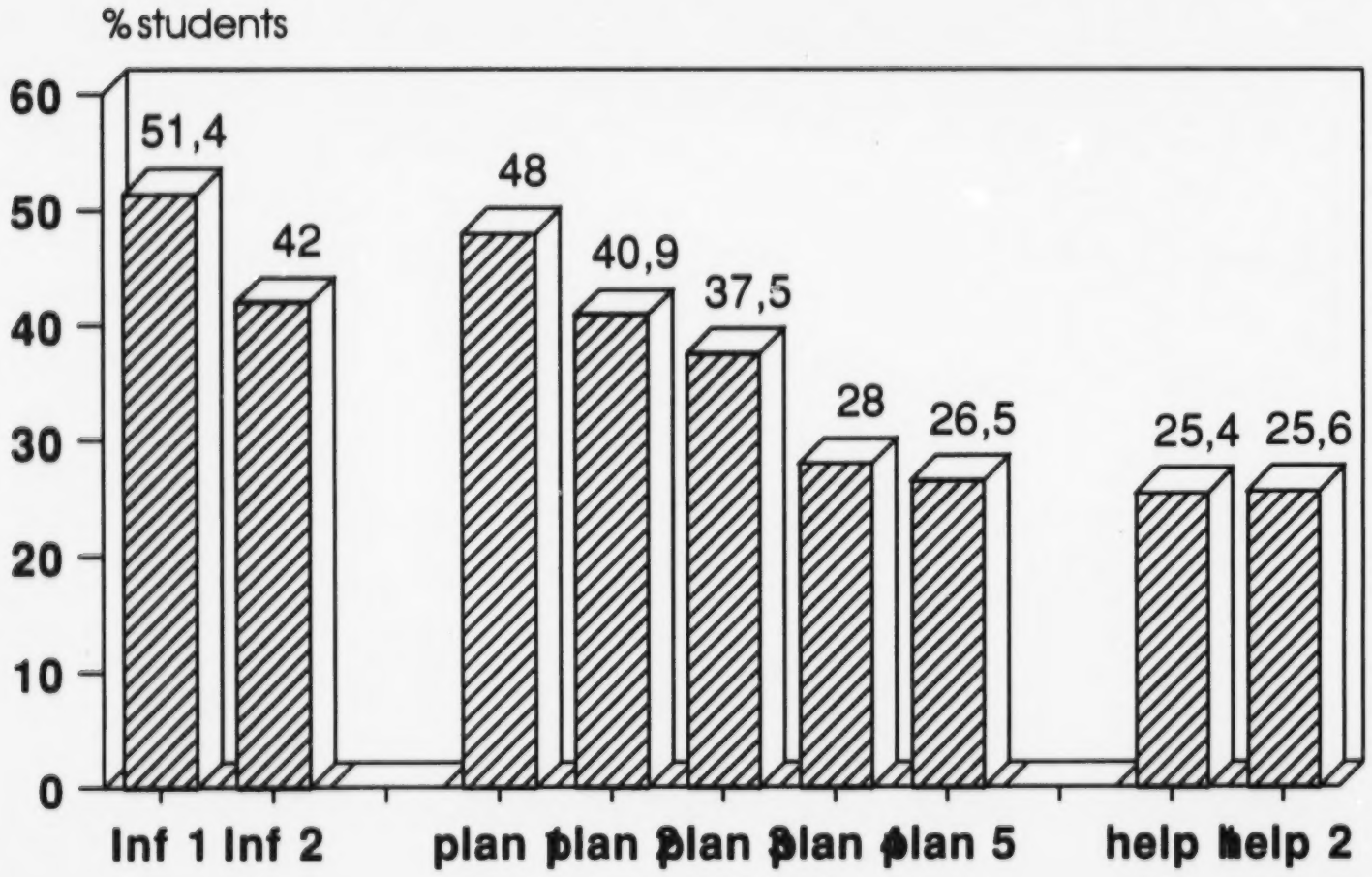
Time investment
in prior knowledge state tests
Interaction with educational level



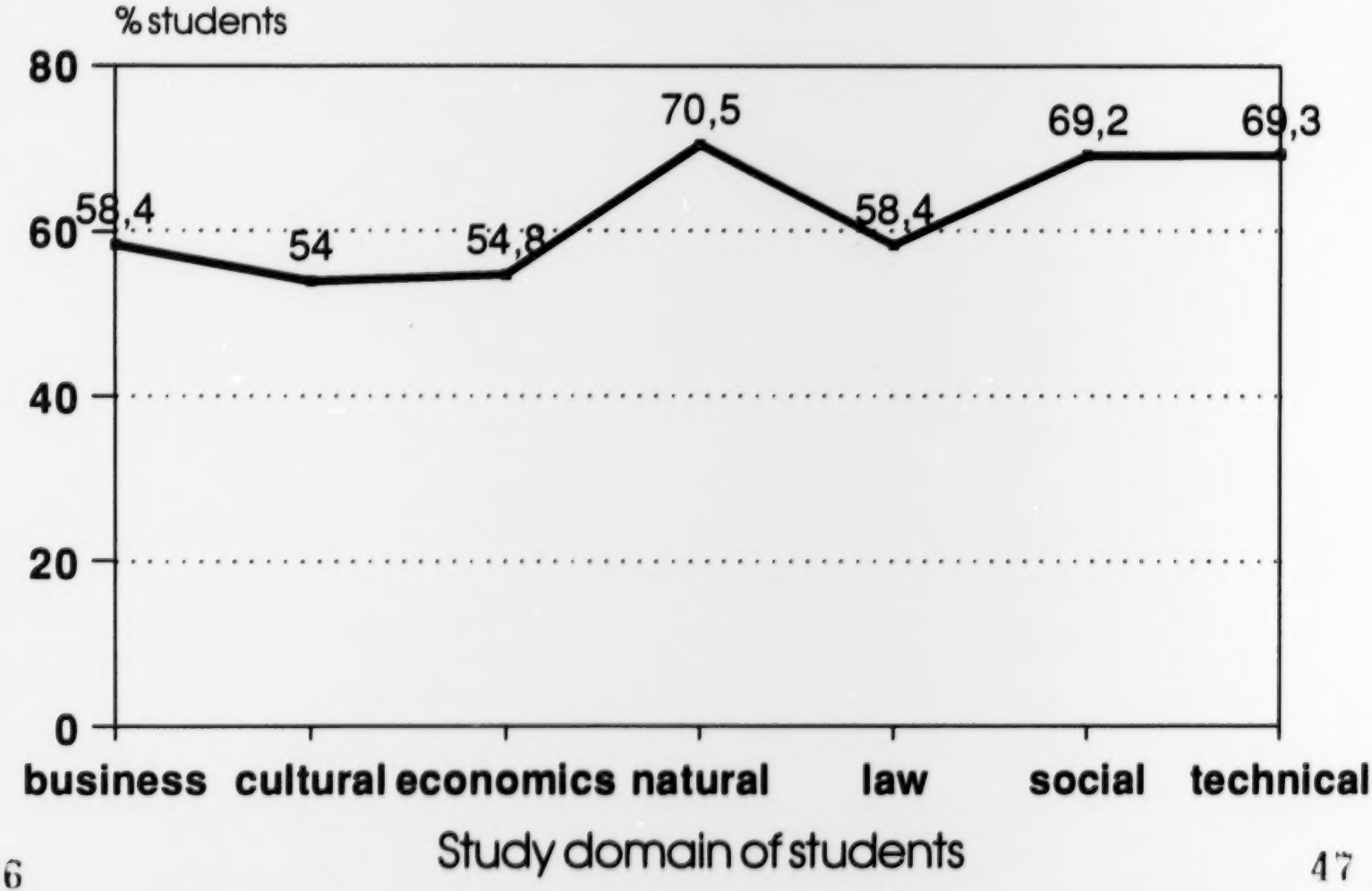
Time investment
in prior knowledge state tests
Interaction with study domains



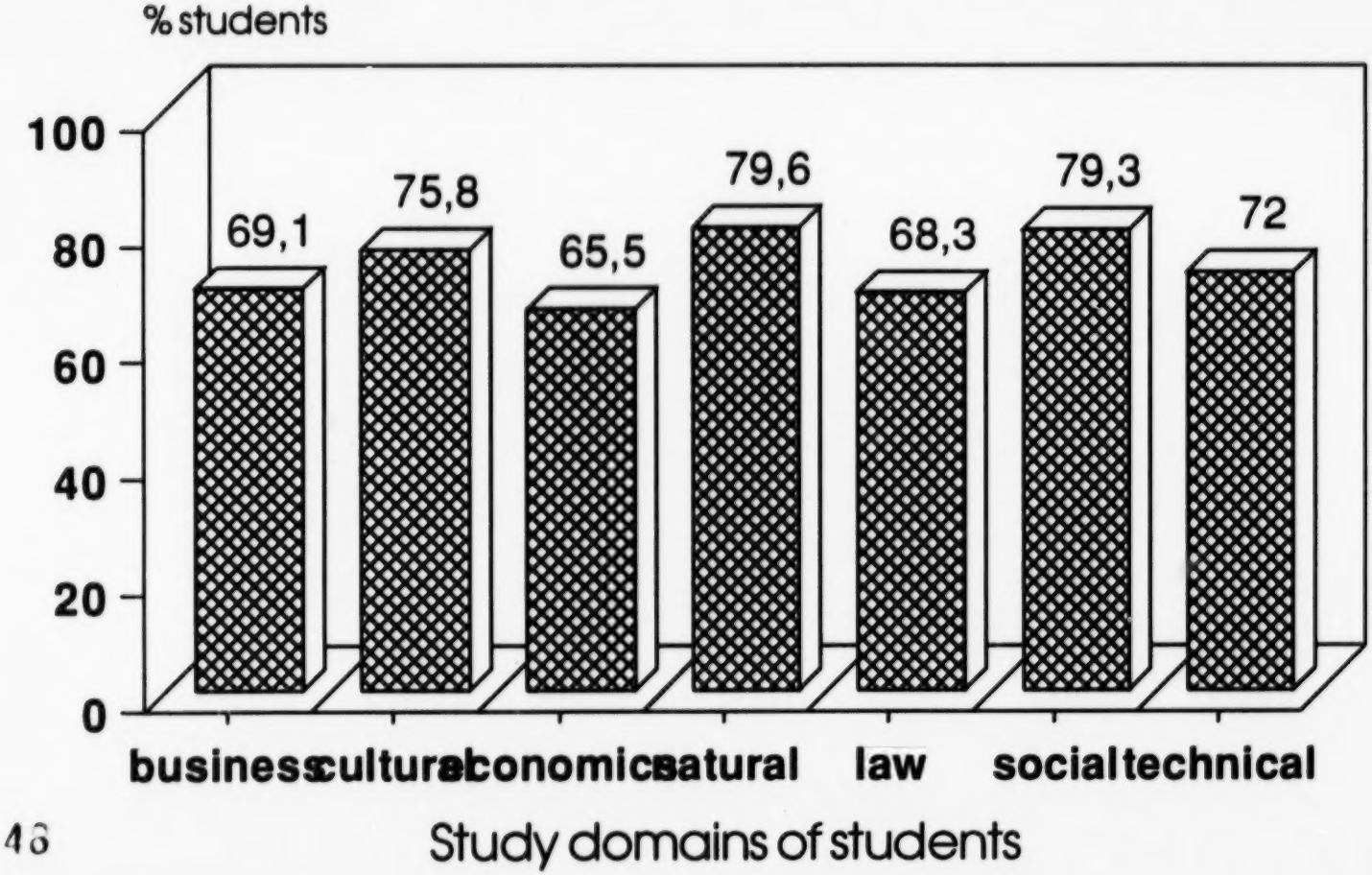
Informative value
of prior knowledge profiles
% acceptance of three clusters



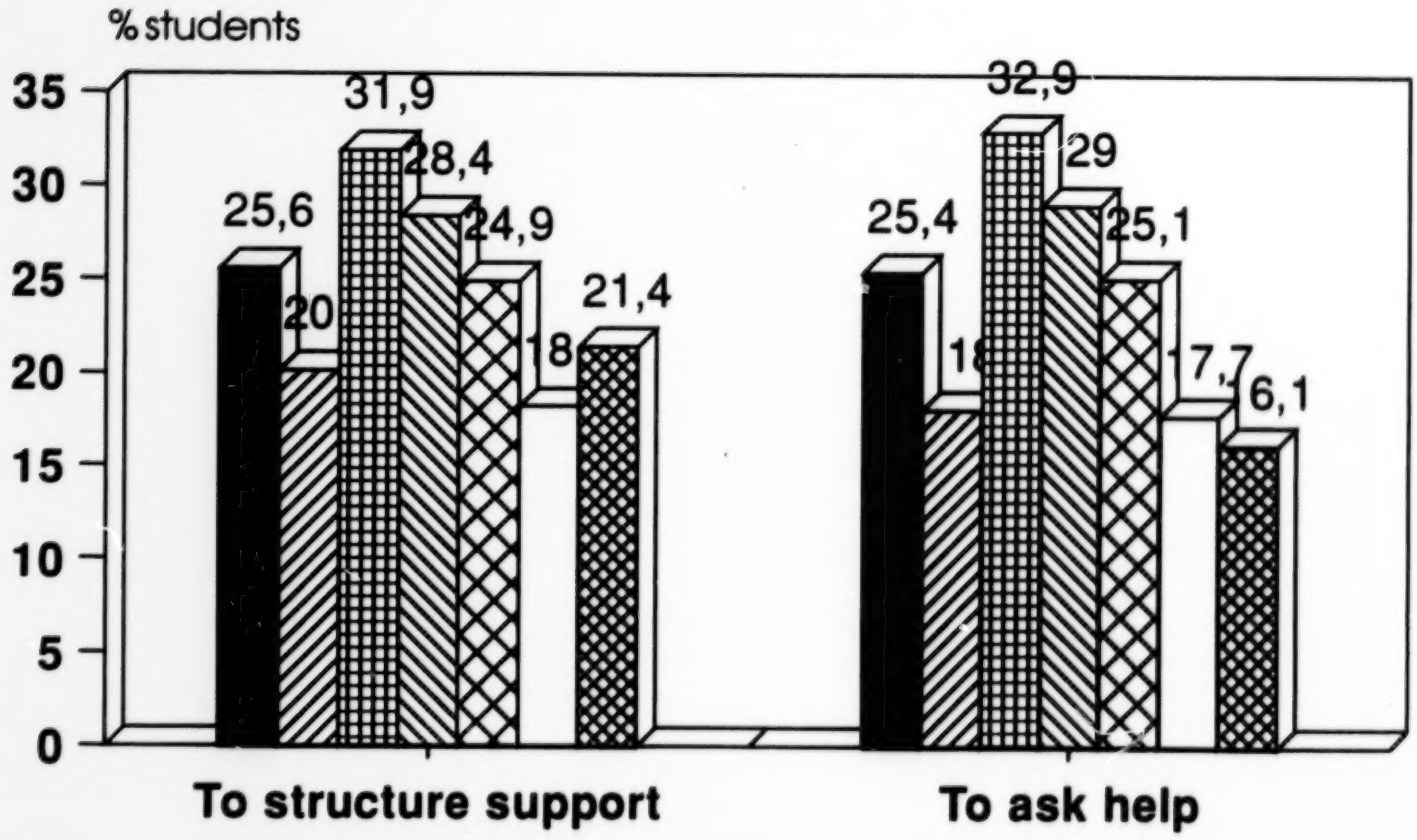
Prior knowledge tests and study route
Interaction with study domain



Prior knowledge tests : a tool
to control mastery of the study process
Interaction with study domains



Prior knowledge and help/support
Interaction with student type variables



Prior knowledge state tests
Advise from experts
Interaction with student type variables